CS7000™

Service Manual

Advance CS7000 Hybrid LPG, Model Number 56509000

Advance CS7000 Hybrid Diesel, Model Number 56509001

Advance CS7000 B, Model Number 56509002

Advance CS7000 Hybrid LPG EcoFlex™, Model Number 56509006

Advance CS7000 Hybrid Diesel EcoFlex™, Model Number 56509007

Advance CS7000 B EcoFlex™, Model Number 56509008

Advance CS7000 Fuel Cell EcoFlex™, Model Number 56383115

Advance CS7000 Hybrid Gasoline EcoFlex™, Model Number 56511001

Nilfisk CS7000 Hybrid LPG EU, Model Number 56509003

Nilfisk CS7000 Hybrid Diesel EU, Model Number 56509004

Nilfisk CS7000 Battery EU, Model Number 56509005

Nilfisk CS7000 Hybrid Petrol EcoFlex™, Model Number 56111002

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English

05/11 Revised 02/13 Form No. 56043151

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General Information

General Machine Description

The CS7000 machines are industrial automatic rider sweeper/scrubbers with multiple sweep/scrub single-pass coverage. Both battery (all electric) and hybrid (LPG and diesel) models are available with or without the EcoFlex™ and DustGuard™ options. The scrub system uses three disc scrub brushes with variable scrub pressure and solution flow rates. The sweep system has a center main broom and left- and right-hand side brooms.

A fuel cell powered model has also been added. It is virtually a battery model that has had the large mono-block battery replaced with a fuel cell provided by Plug Power.

Service Manual Purpose and Application

This Service Manual a technical resource designed to aid service personnel in maintaining and repairing the CS7000 Sweeper/Scrubber to ensure optimum performance and long service life. Please read it thoroughly before servicing your machine.

Revision History

- 8/11 - Not available
- 6/12
  - General Information - Technical specifications table updated
  - Control System - Updated Configuration Display, Configuration Menu and User Options Menu Sections. Added “Power Distribution Fault” to fault code table. Updated installation instructions fro main machine controller.
  - Electrical System - Added information on new LED headlights. Added wiring connection diagram for K14 Safety Relay and K15 Auxiliary Relay
  - Engine LPG - Updated Functional Description of engine RPM control. Updated Troubleshooting for RPM Control problem.
- 2/13
  - General Information - Introduce Fuel Cell powered model
  - Engine System, Petrol (Gasoline) - Add new chapter
  - Electrical System - Updated wiring diagram
  - Wheel System, Traction - Add information on fastening electrical cables to the drive controller.

Other Reference Manuals and Information Sources

Nilfisk-Advance Publications

Model Name	Model Number	Instructions for Use Form Number	Parts List Form Number
Advance CS7000 Hybrid LPG	56509000	56041979: English, Spanish, French	56042540
Advance CS7000 Hybrid Diesel	56509001		
Advance CS7000 B	56509002		
Advance CS7000 Hybrid LPG EcoFlex™	56509006		
Advance CS7000 Hybrid Diesel EcoFlex™	56509007		
Advance CS7000 B EcoFlex™	56509008		
Nilfisk-Advance CS7000 Hybrid LPG EU	56509003	56041980: English, Turkish, Bulgarian, Romanian	56042541
Nilfisk-Advance CS7000 Hybrid Diesel EU	56509004		
Nilfisk-Advance CS7000 Battery EU	56509005	56041981: Danish, Norwegian, Swedish, Finnish	
		56041982: German, French, Dutch, Russian	
		56041983: Spanish, Portuguese, Italian, Greek	
		56041984: Estonian, Latvian, Lithuanian, Slovenian	
		56041985: Slovakian, Czech, Polish, Hungarian	

These manuals can be found on the following Nilfisk-Advance's electronic supported databases:

- Nilfisk-Advance Dealer Customer Zone
- Nilfisk-Advance website: www.Nilfisk-Advance-us.com
- EzParts service / parts CD-ROM

Engine Manufacturers' Technical Manuals

Engine Model	Publication Title
Diesel: D1305-E3B-KEA-1	Kubota WSM Workshop Manual, Diesel Engine, 05-E3B Series, 05-E3BG Series
LPG: WG972-GL-E3-NFK-1	Kubota WSM Workshop Manual, Gasoline, LPG Engine, WG752-G-E3, WG752-GL-E3, WG972-G-E3, WG972-GL-E3

Conventions

All references to right, left, front and rear in this manual are as seen from the Operator's seat position.

Parts and Service

Repairs should be performed by an Authorized Nilfisk-Advance Service Center that employs factory-trained service personnel and maintains an inventory of Nilfisk-Advance original replacement parts and accessories.

Call the Nilfisk-Advance Dealer named below for repair parts or service. Please specify the Model Number (same as the Part Number) and Serial Number when discussing your machine.

(Dealer, affix service sticker here.)

***Note:** *On Fuel Cell models, all issues related to the fuel cell must be referred to Plug Power, not Nilfisk-Advance.*

Nameplate

The Part (Model) Number and Serial Number of your machine are shown on the Nameplate located on the top of the machine frame, at the left rear side of the machine underneath the recovery tank. To access the Nameplate, tip the recovery tank out away from the machine.

This information is needed when ordering repair parts for the machine.

Cautions and Warning Symbols

Nilfisk-Advance uses the symbols below to signal potentially dangerous conditions. Read this information carefully and take the necessary steps to protect personnel and property.

Danger! Is used to warn of immediate hazards that will cause severe personal injury or death.

Warning! Is used to call attention to a situation that could cause severe personal injury.

Caution! Is used to call attention to a situation that could cause minor personal injury or damage to the machine or other property.

General Safety Instructions

Warning! Be sure to follow these safety precautions to avoid situations that could cause severe personal injury.

- This machine should only be used by properly-trained and authorized persons.
- While on ramps or inclines, avoid sudden stops when loaded. Avoid abrupt sharp turns. Use low speed down hills. Clean only while ascending (driving up) the ramp.
- Keep sparks, flame and smoking materials away from batteries. Explosive gases are vented during normal operation.
- Charging the batteries produces highly-explosive hydrogen gas. Charge the batteries only in well-ventilated areas away from open flame. Do not smoke while charging the batteries.
- Remove all jewelry when working near electrical components.
- Turn the Key Switch off (O) and disconnect the batteries before servicing electrical components.
- Never work underneath a machine without safety blocks or stands to support the machine.
- Do not dispense flammable cleaning agents, operate the machine on or near these agents, or operate in areas where flammable liquids exist.
- To avoid hydraulic oil injection or injury, always wear appropriate clothing and eye protection when working with or near any hydraulic system.
- Do not operate this machine on ramps or inclines of more than a two-percent gradient.
- Only use the brushes provided with the machine or those specified in the instruction manual. The use of other brushes may impair safety.

Caution! Do not pressure-wash the operator control panel, fuse panel, contactor panel or engine compartment area.

Caution! Be sure to follow these safety precautions to avoid situations that could cause personal injury, damage to property or equipment damage.

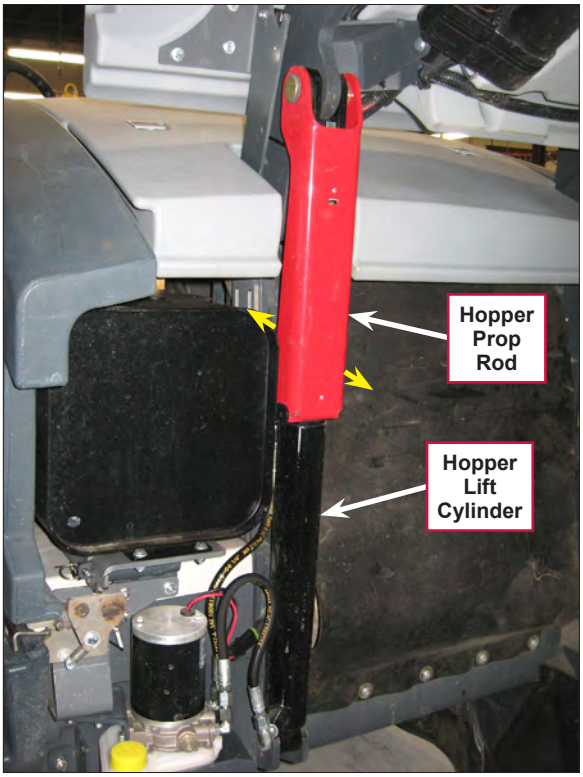
- This machine is not approved for use on public paths or roads.
- This machine is not suitable for picking up hazardous dust.
- Use care when using scarifier discs and grinding stones. Nilfisk-Advance will not be held responsible for any damage to floor surfaces caused by scarifiers or grinding stones.
- When operating this machine, make sure that bystanders, particularly children, are not endangered.
- Before performing any service function, carefully read all instructions pertaining to that function.
- Do not leave the machine unattended without first turning the Key Switch off (O), removing the key and securing the machine.
- Apply the parking brake before exiting the Operator's seat.
- Turn the Key Switch off (O) and remove the key before changing the brushes, and before opening any access panels.
- Take precautions to prevent hair, jewelry or loose clothing from becoming caught in moving parts.
- Use caution when moving this machine in below-freezing temperature conditions. Any water in the solution or recovery tanks, or in the hose lines could freeze, causing damage to valves and fittings. Flush with windshield washer fluid.
- The batteries must be removed from the machine before the machine is scrapped. Disposal of the batteries should be done safely and in accordance with your local environmental regulations.
- Do not use on surfaces having a gradient exceeding that marked on the machine.
- All doors and covers are to be positioned as indicated in the instruction manual before using the machine.
- Refer to the ***Electrical System*** section in this manual for additional specific battery charger warnings.

Hopper Prop Rod

Warning! Never work underneath the raised hopper without the hopper prop rod engaged.

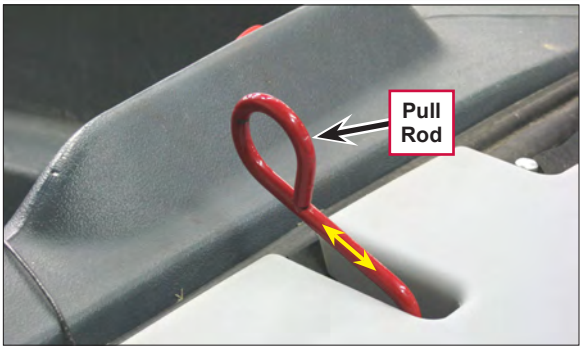
To Engage the Hopper Prop Rod

1. Press and hold the hopper raise button to raise the hopper all the way up.
2. Pull the **Pull Rod** to pivot the bottom of the **Hopper Prop Rod** toward the **Hopper Lift Cylinder** until it contacts the **Hopper Lift Cylinder**.
3. Press and hold the hopper lower button to lower the hopper until the **Hopper Prop Rod** contacts the top of the **Hopper Lift Cylinder**.



To Disengage the Hopper Prop Rod

1. Press and hold the hopper raise button to raise the hopper slightly so the **Hopper Prop Rod** lifts off of the **Hopper Lift Cylinder**.
2. Push the **Pull Rod** to pivot the bottom of the **Hopper Prop Rod** away from the **Hopper Lift Cylinder**.
3. Press and hold the hopper lower button to lower the hopper.



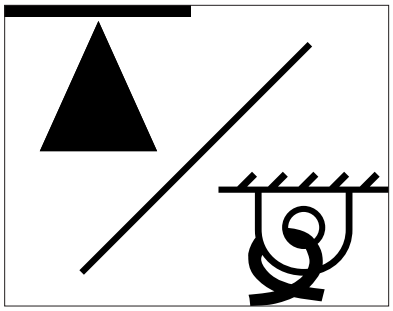
Jacking the Machine

Warning! ***Never work under a machine without safety stands or blocks to support the machine. When jacking the machine, do so at the designated Tie Down/Jacking Locations.***

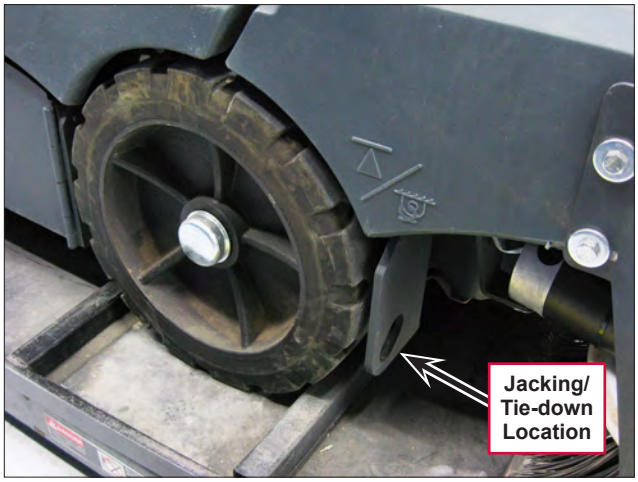
Transporting the Machine

Caution! ***Before transporting the machine on an open truck or trailer, make sure the machine is tied down securely and all access doors and covers are secured (tape and strap as needed).***

The jacking and tie-down locations are identified with a graphic molded into the exterior body panels.



The jacking and tie-down locations are in front of the front wheels, and at the rear of the machine below the solution tank.



Front Jacking/Tie-down Location

Rear Jacking/Tie-down Location

Towing the Machine

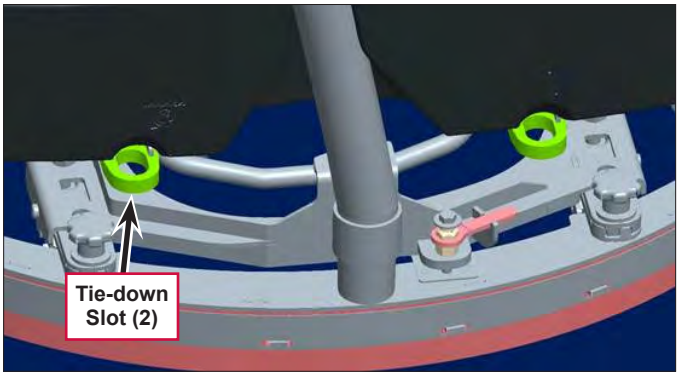
Caution! ***If the machine must be towed, move the machine for short distances only and do not move the machine faster than a normal walking pace (2-3 mph, 3-5 kph).***

Tow the machine backward from one of the rear frame tie-down locations as shown below. Do not push the machine due to the possibility of damage to the solution and recovery tanks.

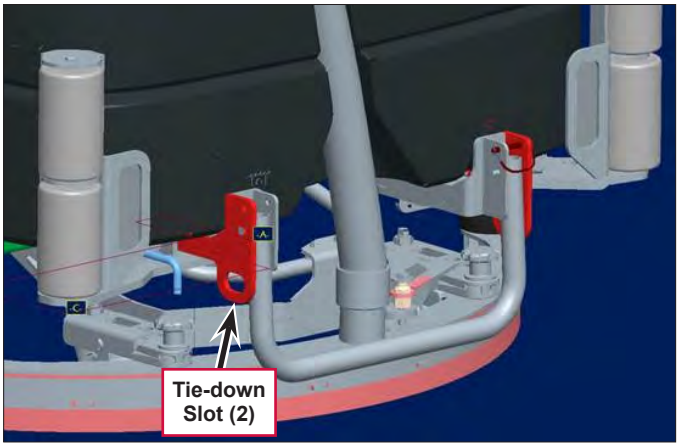
Do not tow the machine by the squeegee tool.

- To enter the "Push Mode", which allows steering while towing the machine, turn the Key Switch on while pressing and holding both the Speed Switch and the High Pressure Wand Switch.

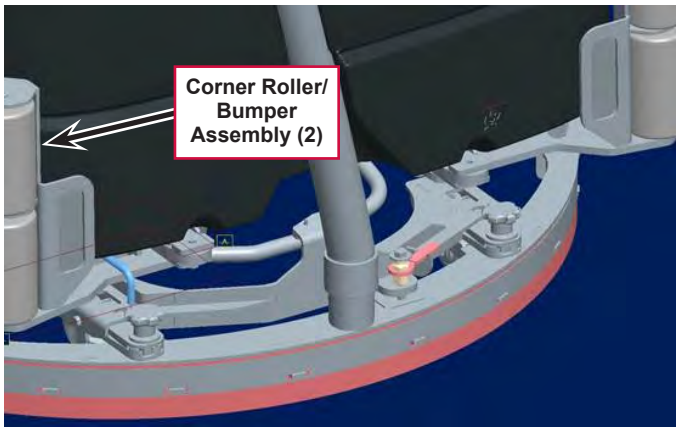
- On machines not equipped with a squeegee guard kit, tow the machine by one of the two **Tie-down Slots** on the chassis (shown in green).



- On machines equipped with a squeegee guard kit, tow the machine by the two **Tie-down Slots** on the squeegee guard (shown in red).



- On machines equipped with an “early” rear corner roller kit but no squeegee guard kit, it’s recommended that you remove the left rear **Corner Roller/Bumper Assembly** in order to access a tie-down location for the tow hook. “Later” corner guard kits have been improved to allow use of the left Tie-down Slot for towing without removing the left corner roller/ bumper assembly.



Diagnostic and Service Tools

In addition to a full set of metric and standard tools, the following items are required in order to successfully and quickly perform troubleshooting and repair of Nilfisk-Advance Industrial floor cleaning equipment.

- Laptop computer loaded with current version of EzParts, Adobe Reader and (preferably cellular) internet access
- Digital volt ohmmeter (DVOM) with DC current clamp
- Hydrometer
- Battery load tester for checking 36V and 12V batteries.
- Automotive fuel pressure test gauge (used on diesel engines)
- Static control wrist strap
- Set of torque wrenches
- Hard (printed) copies of service manuals for regularly serviced machines (available at www.advance-us.com and other Nilfisk-Advance websites).

These tools are also available from Nilfisk-Advance, Inc.:

- Vacuum water lift gauge, p/n 56205281

Technical Specifications

General Specifications

Machine Dimensions				
Length	103” [262 cm]			
Width	With right side squeegee assembly pivoted under the machine – 48” [122 cm]			
	With squeegee – 53” [135 cm]			
Height	Without overhead guard – 59” [150 cm]	With overhead guard (US) – 82” [208 cm]	With overhead guard (EU) – 79” [201 cm]	With debris hopper raised – 90” [229 cm]
Minimum Aisle Turnaround Width	Right turn – 102” [259 cm]			
	Left turn – 104” [264 cm]			
Transport Ground Clearance	3” [7,6 cm] (side skirts on scrub deck)			

Machine Weight		
Hybrid LPG	Dry Weight – 3,636 lbs [1,649 kg]	GVW (full solution and dust control tanks) – 4,676 lbs. [2,121 kg]
Hybrid Diesel	Dry Weight – 3,511 lbs [1,593 kg]	GVW (full solution and dust control tanks) – 4,537 lbs. [2,058 kg]
Battery Machine	Dry Weight – 4,682 lbs [2,124 kg]	GVW (full solution and dust control tanks) – 5,716 lbs. [2,593 kg]

Maximum Tire Loading - with full solution and dust control tanks	
Hybrid LPG	146 psi [10,26 kg/cm2]
Hybrid Diesel	137 psi [9,63 kg/cm2]
Battery Machine	148 psi [10,41 kg/cm2]

Battery Configuration		
Hybrid LPG and Diesel	(3) 12-volt battery pack, (1) separate 12-volt engine starting battery	
Battery Machine	US Battery	(1) 36-volt battery, 770 amp-hours, 6 hour rate, 5.4 hour run time
	EU Battery	(1) 36-volt battery, 800 amp-hours, 5 hour rate, 5.4 hour run time

Solution System					
Solution Tank Capacity	75 gal. [284 L]				
Recovery Tank Capacity	75 gal. [284 L]				
Solution Pump	Precision-flow electric pump/solenoid valve				
Flow Rates	One Light	Two Lights	Three Lights	Four Lights	Five Lights
	1 gpm [3,79 L/min]	1.5 gpm [5,68 L/min]	2 gpm [7,57 L/min]	2.5 gpm [9,46 L/min]	3 gpm [11,36 L/min]

EcoFlex™ System	
Refillable Cartridge Capacity	2.2 gal [8,32 L]
Available Dilution Rates	300:1, 256:1, 200:1, 150:1, 128:1, 100:1, 64:1, 50:1, 32:1, and 26:1
Low Detergent Warning	Standard

Scrub System	
Scrub Brushes	Disc (3), 17” [43 cm] dia.
Scrub Path	48” [122 cm]
Brush Motors	[3] 36 VDC, 1 HP, 2750 RPM, 26 Amp

Dust Control/ DustGuard System		
DustGuard Tank Capacity	29 gal. [110 L]	
DustGuard Nozzle Flow Rate	Battery Machine	6.4 gph (size 100 nozzle)
	LP and Diesel Machines	6.7 gph (size 100 nozzle)
Dust Control Motor	36 VDC, 7 Amps average, 8 Amps max.	

Sweep System	
Main Broom	12.2” [31 cm] diameter x 35.4” [90 cm] long
Sweep Path	61” [154 cm] With dual side brooms
Main Broom Motor	36 VDC, 1.14 HP, 3000 RPM, 20 Amps average
Side Broom	15” [38,1 cm] diameter
Side Broom Motor	42 VDC, 2800 RPM (no load), .25 HP
Hopper Weight Capacity	300 lbs [136 kg]
Hopper Volume Capacity	7.0 ft3 [198 L]

Vacuum System		
Vacuum	Sealed	48” H2O
	With 1” dia. Orifice	25” to 30” H2O
Vacuum Motor	42 VDC, 15 Amps average, 17 Amps max.	

Drive System	
Steering	Rear wheel, “steer-by-wire” system. The steering controller receives input from the steering wheel to drive the steering actuator motor. The steering actuator motor drives a gear that meshes to a large ring gear that rotates the drive wheel assembly.
Brakes (service and parking)	Mechanical drum brakes, one on each front wheel, mechanically actuated

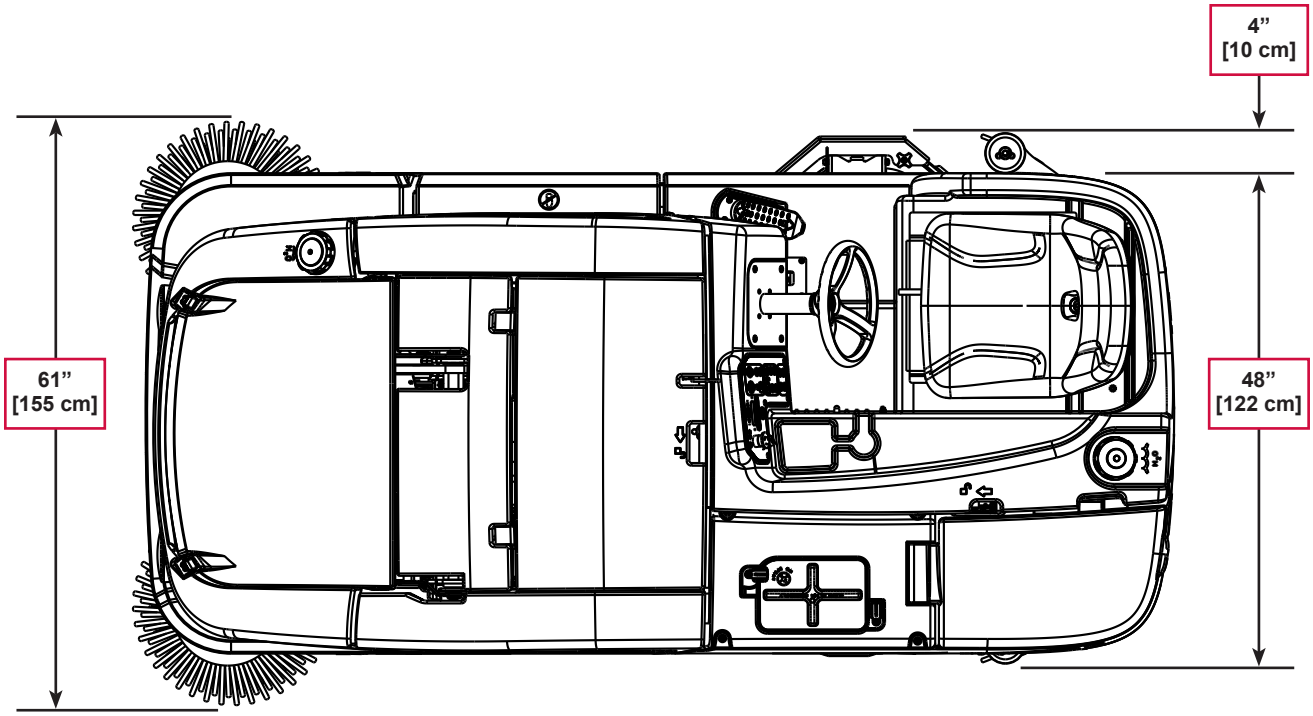
Machine Performance		
Machine Speeds	Transport speed – 5.5 mph [8.85 kph]	
	Scrubbing and sweeping speed – 3.5 mph [5.63 kph]	
Gradeability (vehicle loaded to gross vehicle weight)	Transport – 12 degrees/21% slope	
	Scrubbing/Sweeping – 10 degrees/ 17.6% slope	
Brake Holding	18 degrees/32.5% grade	
Tilt Stability	Empty Tanks – 24.0 degrees/44.5% grade	Full Tanks – 23.0 degrees/37.0% grade
Approach/Trail Angles	Approach Angle – 7.5 degrees/13% grade)	Trail Angle – 20.9 degrees/38% grade)
Maximum Machine Scrub Times	US Battery, 770 amp-hour, 6 hour rate – 5.4 hours run time	EU Battery, 800 amp-hour, 5 hour rate – 5.4 hours run time
Fuel Consumption	Hybrid LPG – 5.5 hours	Hybrid Diesel – 15 hours (approximate)

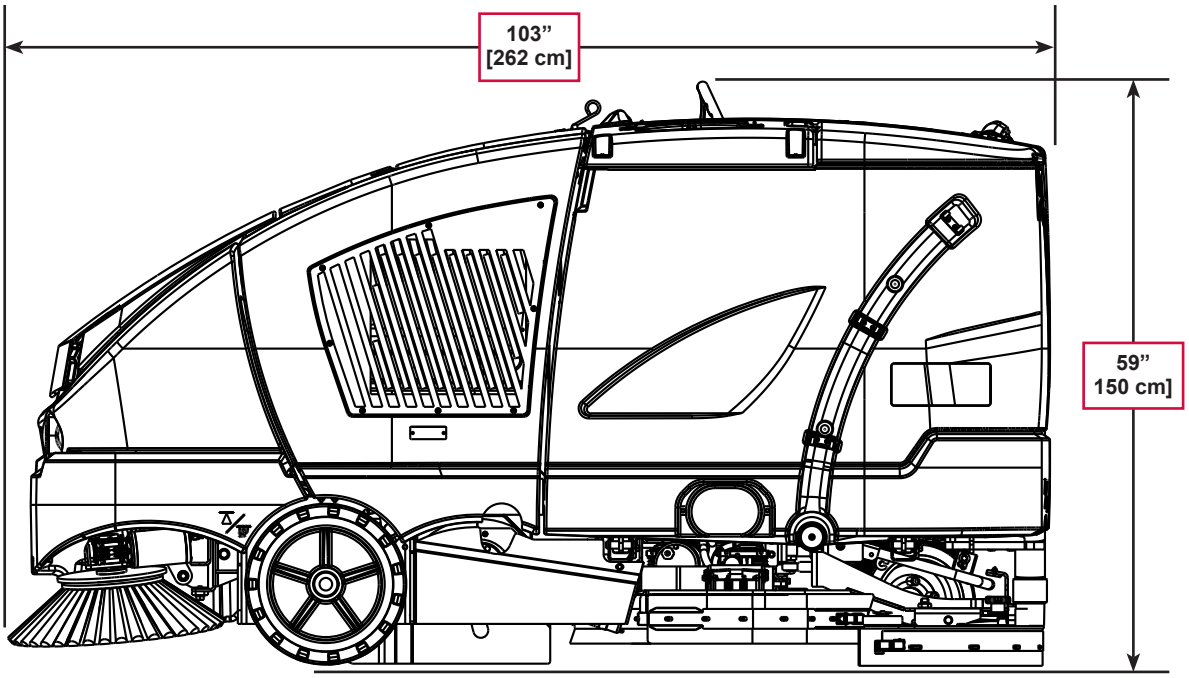
Noise and Vibration			
	Hybrid LPG	Hybrid Diesel	Battery Machine
Operator Sound Levels @ Operator’s Ear	82 dBA	81 dBA	72 dBA
Sound Power	LwA 103	LwA 102	N/A
Hand/Arm Vibration Levels	0.33 m/s2	0.35 m/s2	0.36 m/s2
Operator Seat Vibration Levels	0.03 m/s2	0.03 m/s2	0.02 m/s2

Fastener Torque Specifications

	Size	Plated Steel	Stainless Steel
Standard Torque Specifications (unless otherwise specified)	#10	42 in.-lb.	28 in.-lb.
	1/4“	100 in.-lb.	67 in.-lb.
	5/16”	17 ft.-lb.	11 ft.-lb.
	3/8”	31 ft.-lb.	20 ft.-lb.
	1/2”	75 ft.-lb.	50 ft.-lb.
	3/4”	270 ft.-lb.	180 ft.-lb.
	M5	61 in.-lb.	36 in.-lb.
	M6	9 ft.-lb.	62 in.-lb.
	M8	22 ft.-lb.	13 ft.-lb.
	M10	44 ft.-lb.	25 ft.-lb.
	M12	70 ft.-lb.	40 ft.-lb.

Overall Dimensions





Maintenance

Maintenance Schedule

Keep the machine in top condition by closely following the maintenance schedule. Maintenance intervals given are for average operating conditions. Machines used in severe environments may require service more often. In general:

- Keep the fuel tank filled (diesel). This helps to reduce condensation and moisture entering the fuel system.
- Be aware of the yellow Attention Indicator light, the red Warning Indicator light and the LCD Display on the Operator panel for icons and fault codes that indicate a critical or non-critical fault condition. Refer to the ***LCD Display Icons*** section for a listing and explanation of the LCD display icons and fault codes.
- Refer to the engine service manual for recommended engine service intervals and procedures.

Recommended Service Materials

- Engine Oil (refer to your engine manual)
- Manufacturer-recommended coolant (antifreeze) 50/50 mix (LPG and diesel models only)
- Lithium-base grease
- Loctite® (or equivalent) thread sealant in the appropriate grades
- Never-Seez® (or equivalent) anti-seize compound

Daily Maintenance

Caution! ***Do not pressure-wash the operator control panel, fuse panel, contactor panel or engine compartment area.***

Maintenance Item	Procedure
Perform “After Use” maintenance steps	“After use” maintenance is normally the responsibility of the machine Operator. Refer to the Instructions for Use.
Engine (LPG and diesel only)	Check the engine oil level.
	Check the engine coolant level in the reservoir.
	Check for engine and coolant leaks.
	Check the air cleaner service indicator and service the air filter when the indictor is shown red.
Recovery tank	Check that the drain hose cap is sealed.
	Drain and clean the inside of the tank; flush with clean water.
	Clean the squeegee; check the blades for damage/wear and deflection.
Scrub housing side skirts	Check for damage/wear.
Scrub brushes	Check for debris wrapped around the brushes/brooms and for damage/wear.
Main and side brooms	
Parking brake and foot pedal brake	Check for correct operation of brakes; adjust as needed.

Maintenance Every 15 to 20 Hours

Maintenance Item	Procedure
Battery/Batteries	Check the electrolyte level in the battery.
	Check the battery cables and connections.
Solution tank filter	Inspect and clean the debris filter on the solution filter system.
EcoFlex™ detergent system	Purge the detergent delivery lines.
Sweep brooms	Rotate the main broom.
	Inspect/adjust the main and side brooms.
	Inspect the side broom housing skirts.
DustGuard™	Clean the DustGuard™ system spray nozzles.
Dust hopper	Clean the hopper filter; inspect the hopper seals.

Monthly Maintenance

Maintenance Item	Procedure
Squeegee caster wheel axle and pivot	Pump a small amount of grease into each grease fitting on the machine until grease seeps out around the bearings.
Steering gears	Apply grease to lubricate.
Squeegee tool end wheels	Apply light machine oil to lubricate.
Engine/Battery compartment latch	
Recovery tank latch	
Brake Pedal (parking brake) linkage	

Maintenance Every 150 Hours

Maintenance Item	Procedure
Engine maintenance (LPG and diesel only)	Change the engine oil and oil filter. *Also review the engine manufacturer's additional maintenance requirements.
Radiator and oil cooler (LPG and diesel only)	Inspect and clean the exterior core cooling fins.
LPG fuel system vaporizer/regulator – LPG engines only	Inspect and drain any oil buildup from the LPG fuel vaporizer/ regulator.

Maintenance Every 400 Hours

Maintenance Item	Procedure
Air intake housing and hoses (LPG and diesel only)	Inspect the complete air intake system for correct routing, kinks, restrictions, sound tight connections, holes and cracks in hoses.
Battery/Batteries	Check electrolyte level; check terminals for corrosion, loose connections.
Fuel Filter (diesel only)	Replace fuel filter cartridge (located before injector pump).

Maintenance Every 800 to 1000 Hours

Maintenance Item	Procedure
Engine maintenance (LPG only)	Change the spark plugs.
Radiator	Flush and refill radiator with 50/50 mix of water and antifreeze.
42-volt alternator drive belt	Replace the drive belt.

Maintenance Every 1500 Hours

Maintenance Item	Procedure
Main broom motor carbon brushes	Check and replace as needed.
Side broom motor carbon brushes	Check and replace as needed.

Maintenance Every 1900 Hours

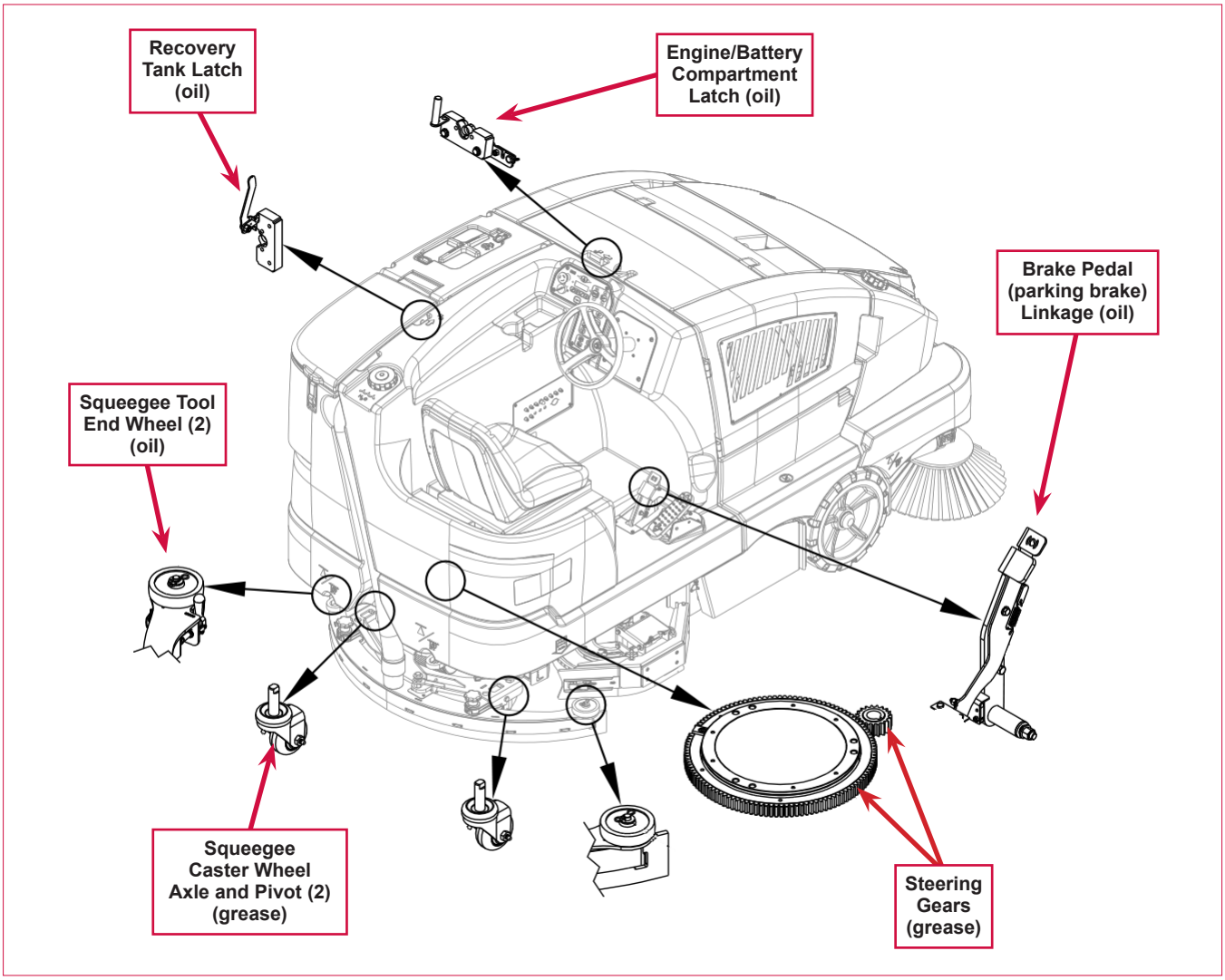
Maintenance Item	Procedure
Scrub brush motor carbon brushes	Check and replace as needed.

Maintenance Every 2000 Hours

Maintenance Item	Procedure
Engine maintenance (LPG and diesel only)	* Review the engine manufacturer's additional maintenance requirements.

***Note:** The engine maintenance schedule shown lists the recommended engine service intervals. Refer to the **Other Reference Manuals and Information Sources / Engine Manufacturers' Technical Manuals** section for list of available engine manufacturers' service manuals. Refer to these manuals for more complete maintenance and service information and instructions.*

Lubrication Points


Recovery Tank Latch (oil)
Engine/Battery Compartment Latch (oil)
Brake Pedal (parking brake) Linkage (oil)
Squeegee Tool End Wheel (2) (oil)
Squeegee Caster Wheel Axle and Pivot (2) (grease)
Steering Gears (grease)

EcoFlex System Maintenance

You will need to purge the system of the previous detergent when switching to a different detergent.

Service Note: *Move the machine over a floor drain before purging because a small amount of detergent will be dispensed in the process.*

To Purge When Changing Detergents (the scrub system must be off)

1. Disconnect and remove the detergent bottles.
2. Turn the key switch on and wait a few seconds for the start-up sequence to finish.
3. Press and hold the detergent switch for approximately two seconds.
4. Release the switch when the detergent purge icon appears on the display and the detergent indicator starts flashing.

Note: *Once activated, the purge process takes at least 10 seconds. Normally one purge cycle is adequate to purge the system.*

To Purge Weekly (the scrub system must be off)

1. Disconnect and remove the detergent bottles.
2. Install and connect bottles filled with clean hot water.
3. Turn the key switch on and wait a few seconds for the start-up sequence to finish.
4. Press and hold the detergent switch for approximately two seconds.
5. Release the switch when the detergent purge icon appears on the display and the detergent indicator starts flashing.

Note: *Once activated, the purge process takes at least 10 seconds. Normally one purge cycle is adequate to purge the system..*

To Change the Detergent Mix Ratio (the scrub system must be on)

1. Press and hold the detergent switch for two seconds.
2. Release the switch once the detergent indicator begins flashing.
3. While the light is flashing, press and release the detergent switch to select the next detergent mixture ratio. Once the desired ratio is selected, the detergent system will return to normal operation within three seconds.

Note: *The detergent mixture will be displayed for approximately 10 seconds each time the scrub mode changes, or each time the detergent switch is pressed. Once set, the detergent flow rate automatically increases and decreases with the solution flow rate, but the detergent mix ratio will remain the same. If an Operator would prefer the flexibility of setting different detergent dilution ratios for different solution flow rates, this specific programming option can be found in the* ***Control System*** *section.*

Note: *During scrubbing, the detergent system can be turned off at any time by pressing the detergent switch to allow scrubbing with water only. No detergent is dispensed until the scrub system is activated and the drive pedal is pushed forward.*

Service Tip: *Follow the* ***To Purge Weekly*** *instructions above if the machine is going to be stored for an extended period of time, or if you plan to discontinue use of the detergent system.*

PM Checklist

Nilfisk-Advance CS7000

PM Checklist

Customer _____

Address _____

City _____ **St** _____ **Zip** _____

Model # _____ **Serial #** _____ **Hours** _____

Defect Codes

A needs adjustment
B binding
C dirty or contaminated
D damaged, bent or torn
L leaks
M missing
W worn out

Ref	Operational Inspection Items	OK	Defect Codes (circle)	Does Not Work
1	Engine idle speed. LP - 1700 RPM; diesel - 1700 RPM		A rough	
2	Engine run speed. LP - 2500 RPM; diesel - 2200 RPM		A low power	
3	Engine maximum power speed. LP - 2700 RPM; diesel - 2400 RPM		A low power	
4	Drive pedal operation (check for forward/reverse drive and any neutral creep)		A B	
5	Drive system performance (max forward transport speed 5.5 mph)		noisy sluggish	
6	Brakes (check both service and parking)		A B W	
7	Steering		not functioning	
8	Main broom raise/lower		B D	
9	Main broom on/off		B D	
10	Side sweep brooms raise/lower		A B	
11	Side sweep brooms on/off		B L	
12	DustGuard™ (water nozzles) on/off		A C L	
13	Dust control filter		C D	
14	Scrub system (raise/lower and auto scrubbing functions)		<----->	
15	Scrub brushes on/off (will drift)		<----->	
16	Scrub brush (pressure settings 1, 2 and3)		A B	
17	Solution control (on/off and five flow settings)		C D	
18	Test and purge the EcoFlex™ detergent system (if so equipped)		C L W	
19	Squeegee system (raise/lower and auto lift in reverse)		<----->	
20	Vacuum performance - 48" of H_2O sealed; 25” to 30” of H_2O with 1” diameter orifice		C L	
21	Headlights, gauges and (optional) accessories rotating beacon, backup alarm		<----->	
22	Tilt steering mechanism and seat adjustment lever		<----->	

Ref	Visual Inspection Items	Comments	OK	Defect Codes (circle)	Does Not Work
23	Main broom bristles	min. bristle length 2” [5 cm]		A B D W	
24	Main broom motor			B D	
25	Side sweep broom bristles	min. bristle length 3” [7,63 cm]		A B D W	
26	Side broom motors			B D	
27	Scrub brush motors			B D	
28	Main scrub brushes, check for wear and rotate			D W	

Ref	Visual Inspection Items	Comments	OK	Defect Codes (circle)	Does Not Work
29	Scrub deck housing and door skirts			C D W	
30	Solution system pumps and solenoid valves	as many as six pumps		C L W	
31	Solution tank, delivery hoses and filter	clean filter screen		C L M	
32	Dust control system impeller motor			C L D	
33	Recovery tank screen and float	clean screen		B C	
34	Recovery tank debris basket	clean		C	
35	Recovery tank cover gasket			D L W	
36	Recovery tank drain hose and cap			C D L M	
37	Squeegee pick-up hose	back flush		C L	
38	Squeegee tool and blades	clean and rotate		C D W	
39	Squeegee casters, adjustment knob and linkage	grease		C W	
40	Battery/Batteries	clean and water		C	
41	Engine, oil level, hoses and belts (LP and diesel only)			C D L	
42	Engine air cleaner inner and outer elements (LP and diesel only)	check service indicator		C L	
43	Engine coolant level (LP and diesel only)	fill at reservoir		C L	
44	Radiator and oil cooler core blockage (LP and diesel only)	clean		C D L	
45	Fuel tank, filter and lines (diesel only)			C L W	
46	LP tank, hoses and fittings (LP only)			L W	
47	LP fuel filter	service life 1500 hrs.		C	
48	LP fuel regulator, lock off valve and hoses			L	
49	Diesel glow plug function light	hard starting		<----->	
50	Diesel fuel tank strainer	yearly		C	
51	Brake linkage and parking brake pedal			A B	
52	Circuit breaker panel			D M W	
53	Front tires (check lug nut torque 100 ft-lbs., 135 Nm)			A	
54	Rear drive wheel motor, steering system	grease pinion gear		D L W	
55	Front and rear tires	tread wear		C W	
56	Debris hopper	clean		C	
57	Recovery hose and pick-up screen	back flush/clean		C	
58	DustGuard™ spray nozzles and strainers	clean		C L W	

Note: *For additional service information, see the CS7000 Service Manual, form number 56043151, and the Instructions For Use for your machine model.*

Work Completed By: **Acknowledged By:**

Service Technician Signature **Date** **Customer Signature** **Date**

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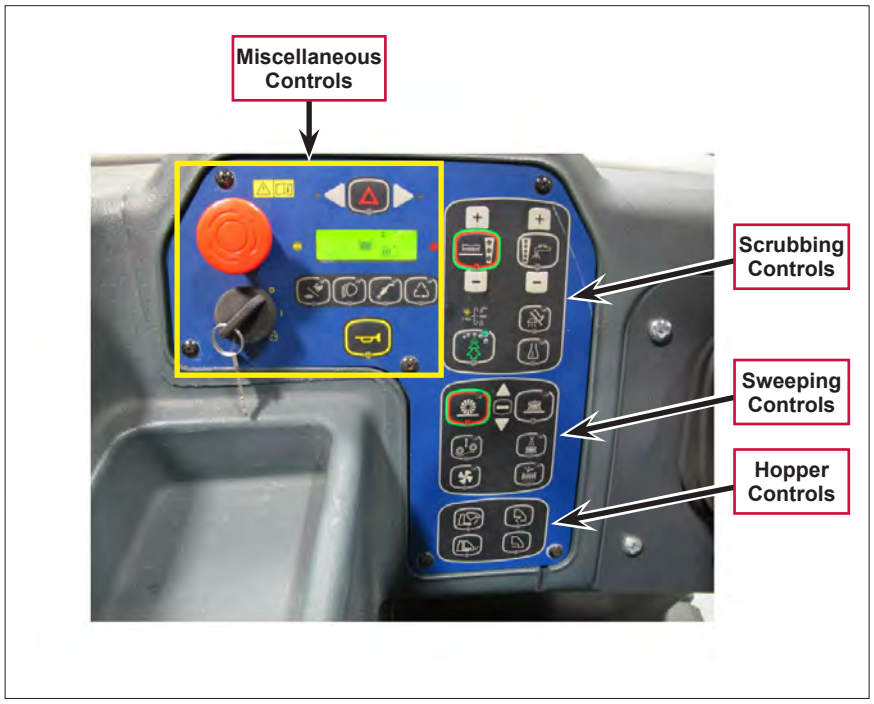
Machine Controls

Control Panel - General Layout

The CS7000 control panel is organized by machine function with the scrub, sweep and hopper functions conveniently grouped together. Miscellaneous controls such as the key switch, emergency-stop switch, speed control, light switch, high-pressure wand switch, extended scrub system switch and horn button are located in front of the Operator.

***Note:** The switches with a "**I**" below them are press-and-release switches. The buttons noted with an "**T**" below them are momentary buttons.*



Miscellaneous Controls

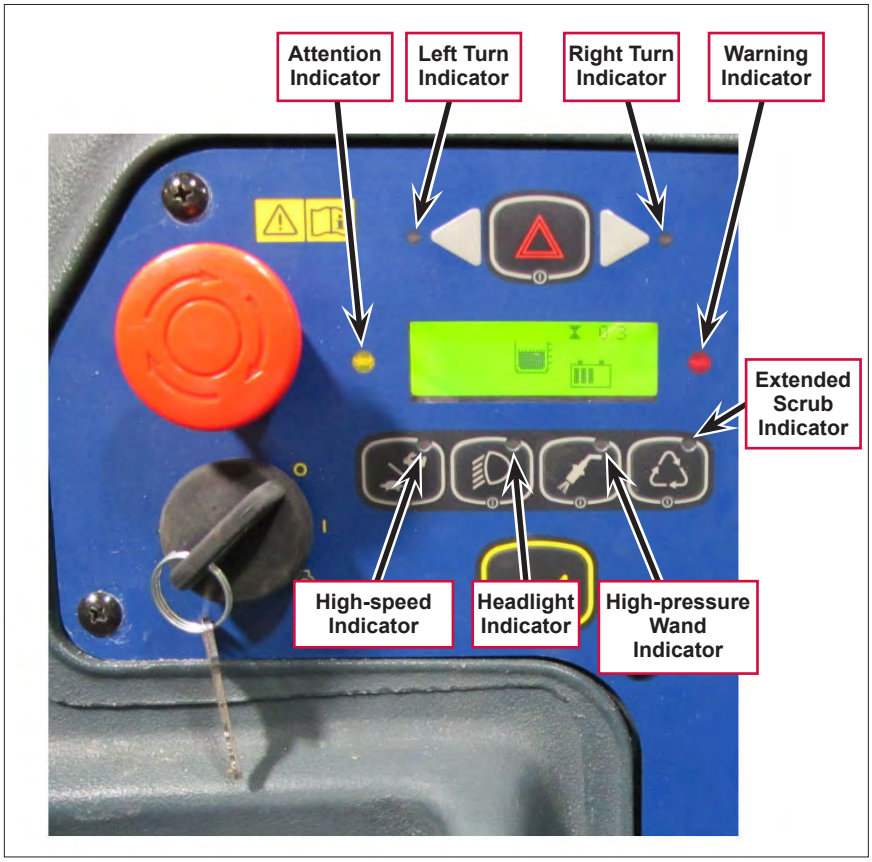
- **Emergency Stop** – maintained palm switch; removes off all power to the machine functions when pressed. To reset the **Emergency Stop** switch, rotate the red knob clockwise.
- **Left** and **Right Turn Signal** – switch on the corresponding turn signal.
- **Hazard Flasher** – (optional) switches on the four-way hazard flashers.
- **Key Switch** – main power/ ignition switch.
- **LCD Display** – displays the various machine status icons and informational displays.
- **Speed Switch** – functions as follows:
  - LPG and diesel machines – increments the engine speed up and down through the three speed ranges. Note that the engine speed will increase automatically when certain machine functions are engaged.

– Battery machines – increases the machine scrub speed to the full transport speed.

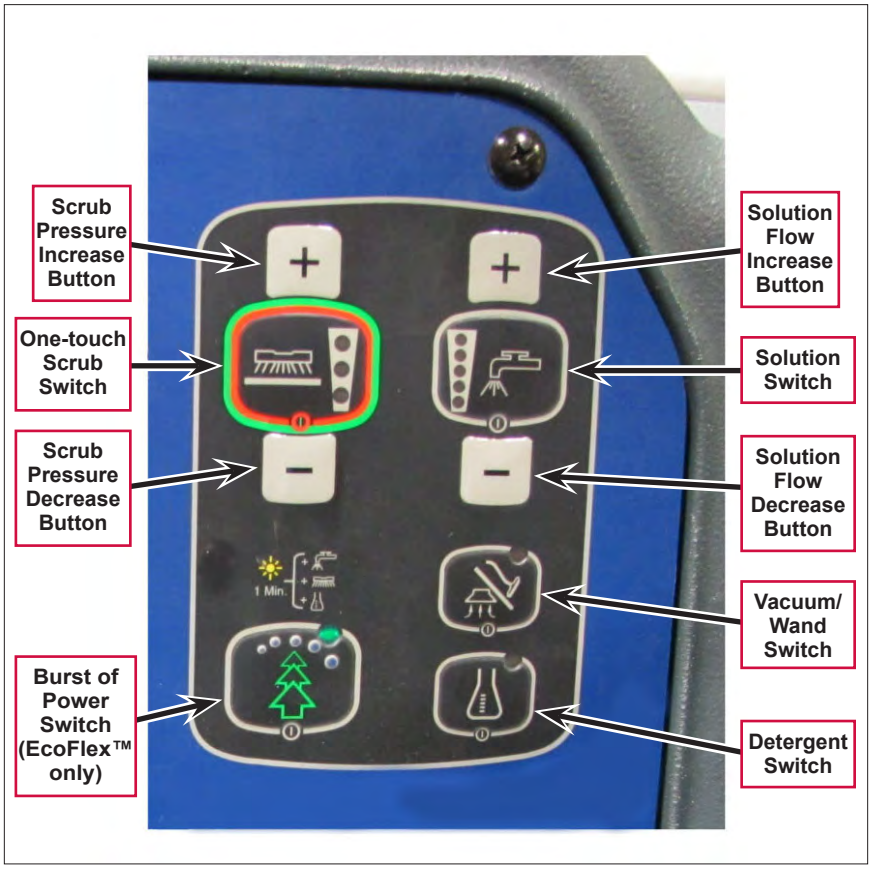
- **Headlight Switch** – switches on the headlights.
- **Horn Button** – sounds the horn when pressed.
- **High-pressure Wand Switch** – engages the high-pressure spray wand solution pump (LPG and diesel only).
- **Extended Scrub Switch** – enables the optional extended scrub (recycle) function.

Miscellaneous Indicators

- **Attention Indicator** – lights to alert the Operator of a machine condition requiring attention.
- **Left** and **Right Turn Indicators** – indicates that the corresponding turn signal is flashing.
- **Warning Indicator** – lights to alert the Operator of a warning or fault condition.
- **Extended Scrub Indicator** – lights to indicate that the extended scrub function is enabled.
- **High-speed Indicator** – lights to indicate that the engine is running at high speed.
- **Headlight Indicator** – lights to indicate that the headlights are on.
- **High-pressured Wand Indicator** – lights to indicate that the wand high-pressure pump is engaged.



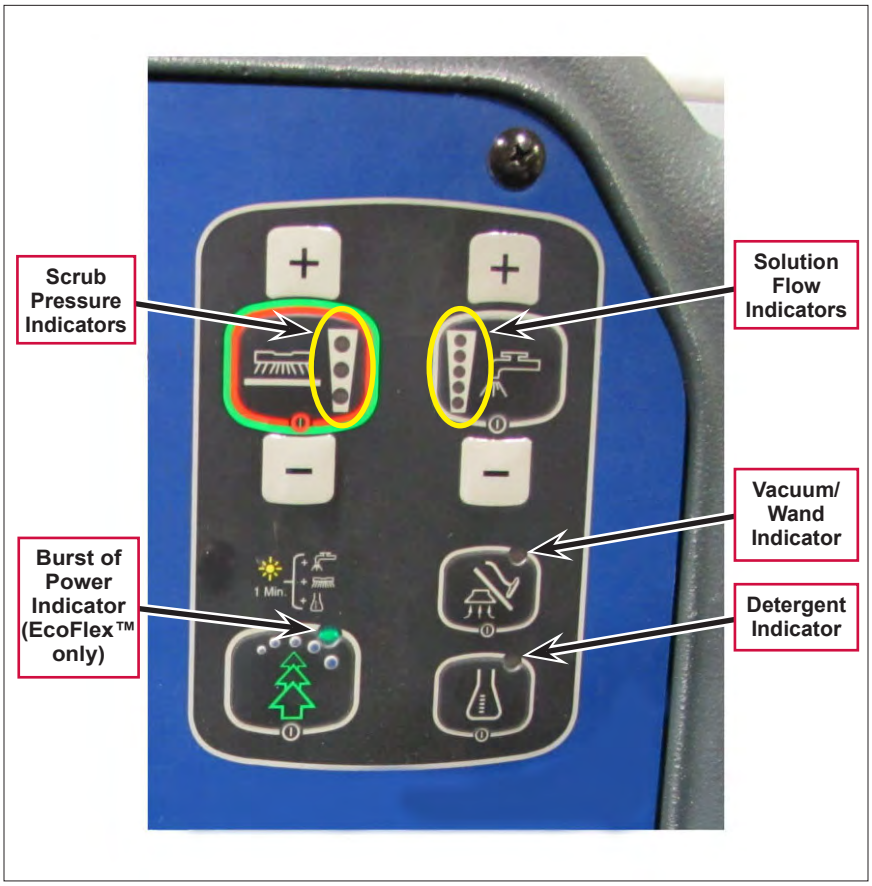
Scrub Controls



- **Scrub Pressure Increase Button** – increases the scrub pressure one level when pressed. Note that the scrub pressure LED indicators in the **One Touch Scrub Switch** will light to indicate the selected scrub pressure.
- **One Touch Scrub Switch** – enables the scrub, solution and recovery systems, and the EcoFlex™ system (if the machine is so equipped). Note that the scrub brush pressure and solution flow will be at their lowest levels. The scrub brushes will run, the solution will flow and the squeegee vacuum will turn on when the machine begins moving forward.
- **Scrub Pressure Decrease Button** – decreases the scrub pressure one level when pressed.
- **Burst Of Power Switch** – increases both the scrub brush pressure and solution flow one step higher for 60 seconds.
- **Solution Flow Increase Button** – increases the solution flow rate one level when pressed. Note that the solution flow LED indicators in the **Solution Switch** will light to indicate the selected solution flow rate.
- **Solution Switch** – enables and disables the solution system.
- **Solution Flow Decrease Button** – decreases the solution flow rate one level when pressed.
- **Vacuum/Wand Switch** – enables and disables on the vacuum system.
- **Detergent Switch** – enables and disables the detergent system (on models so equipped).

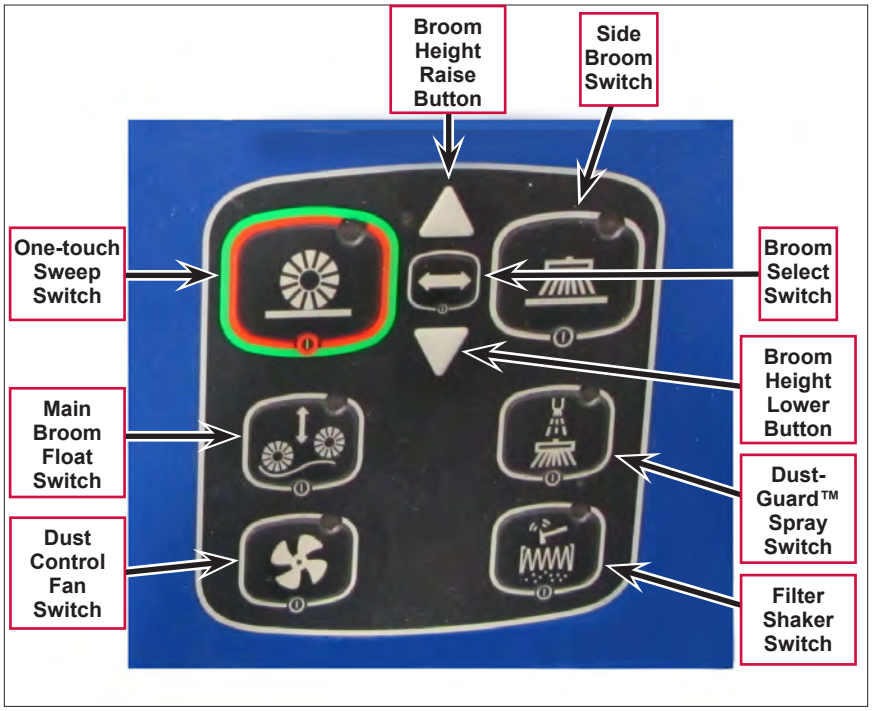
Scrub Indicators

- **Scrub Pressure Indicators** – indicate the scrub pressure setting. One LED indicates the lightest scrub pressure and three LEDs indicates the heaviest scrub pressure.
- **Burst of Power Indicator** – lights during normal operation; flashes to indicate a 60-second burst of power.
- **Solution Flow Indicators** – indicate the solution flow setting. One LED indicates the lowest solution flow and five LEDs indicate the highest solution flow.
- **Vacuum/Wand Indicator** – indicates that the vacuum system is enabled.
- **Detergent Indicator** – indicates that the detergent system is enabled.



Sweep Controls

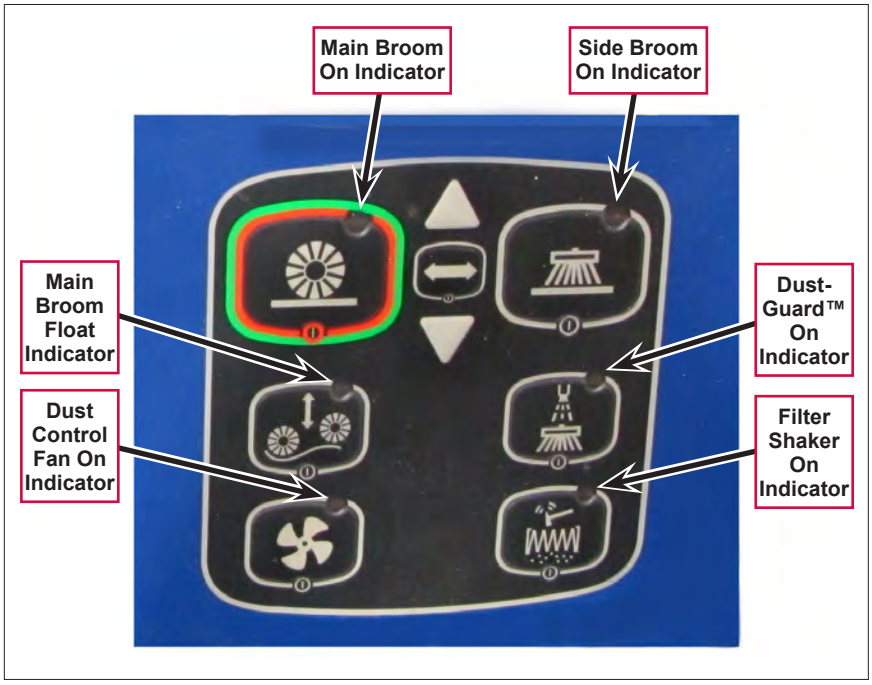
- **Broom Height Raise/Lower Buttons** – raise and lower the selected broom from its current position.
- **Side Broom Switch** – enables and disables the side brooms. Note that if you switch off the side brooms, the DustGuard™ spray nozzles will also switch off.
- **One-touch Sweep Switch** – enables the main broom, side brooms, dust control fan and DustGuard™ spray nozzles.
- **Main Broom Float Switch** – directs the main machine controller to drive the main broom actuator all the way down so the weight of the main broom is resting on the floor. The linkage is slotted to allow the broom to follow the contour of the floor.



- **Dust Control Fan Switch** – enables and disables the dust control fan.
- **Broom Select Switch** – functions as follows:
  - When the one-touch sweep is enabled, the **Broom Select Switch** selects the broom (main broom or side brooms) that will be raised or lowered when the **Broom Height Raise Button** and **Broom Height Lower Button** are pressed.
  - When the one-touch sweep is not enabled, pressing the **Broom Select Switch** once will lower the side brooms, switch on the side broom motors for a short time, then raise the side brooms. Pressing the **Broom Select Switch** twice will lower the main broom, switch on the main broom motor for a short time, then raise the main broom.
- **DustGuard™ Spray Switch** – enables and disables the DustGuard™ spray nozzles.
- **Filter Shaker Switch** – switches on the filter shaker. The shaker will cycle 16 times, then switch off.

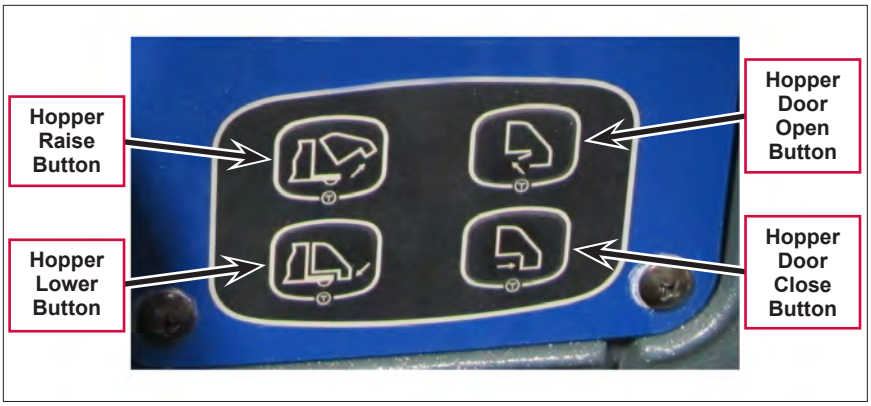
Sweep Indicators

- **Main Broom On Indicator** – indicates that the main broom is enabled.
- **Side Broom On Indicator** – indicates that the side brooms are enabled.
- **Main Broom Float Indicator** – indicates that the main broom is set to the "float" mode.
- **Dust Control Fan On Indicator** – indicates that the dust control fan is enabled.
- **DustGuard™ On Indicator** – indicates that the DustGuard™ system is enabled.
- **Filter Shaker On Indicator** – indicates that the filter shaker motor is running.


Main Broom On Indicator
Side Broom On Indicator
Main Broom Float Indicator
Dust Control Fan On Indicator
Dust-Guard™ On Indicator
Filter Shaker On Indicator

Hopper Controls

- **Hopper Raise Button** – raises the hopper.
- **Hopper Lower Button** – lowers the hopper.
- **Hopper Door Open Button** – opens the hopper door.
- **Hopper Door Close Button** – closes the hopper door.

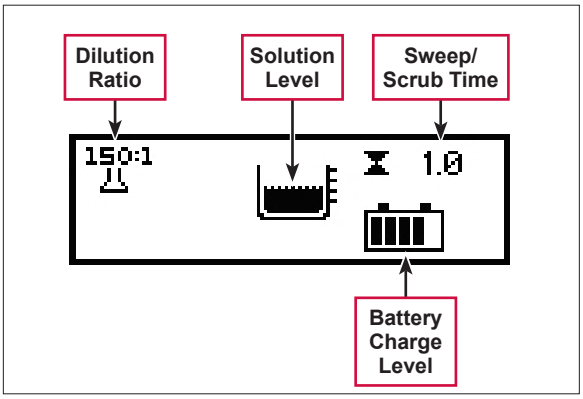


LCD Displays

General Displays

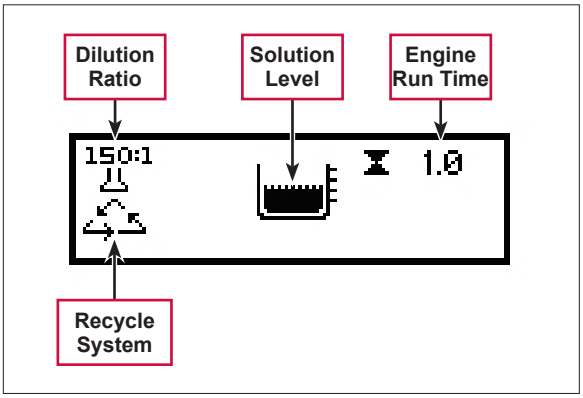
Battery Machine

The general LCD display on the battery machine shows the solution level in the solution tank, the total sweep/scrub time on the hour meter, and the state of battery charge. If the machine is equipped with an EcoFlex™ system, the display will also show the detergent system icon and current dilution ratio.



LPG Machine

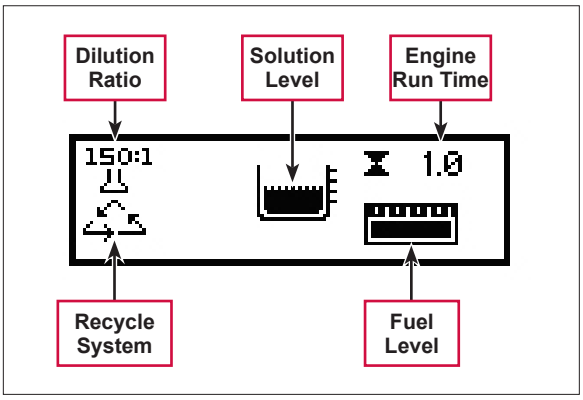
The general LCD display on the LPG machine shows the solution level in the solution tank, the total engine run time and the recycle system icon (if actuated). If the machine is equipped with an EcoFlex™ system, the display will also show the detergent system icon and current dilution ratio.



Note: *No battery charge or fuel level will be displayed while the engine is running.*

Diesel Machine

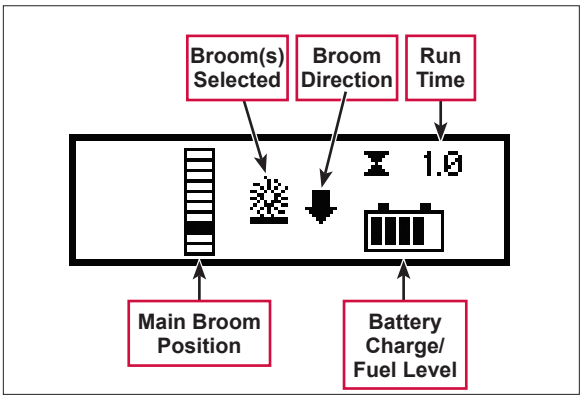
The general LCD display on the diesel machine shows the solution level in the solution tank, the total engine run time, the recycle system icon (if actuated) and the fuel tank level. If the machine is equipped with an EcoFlex™ system, the display will also show the detergent system icon and current dilution ratio.



Note: *The fuel level will be displayed while the engine is running.*

Broom Adjustment (Battery, LPG and Diesel)

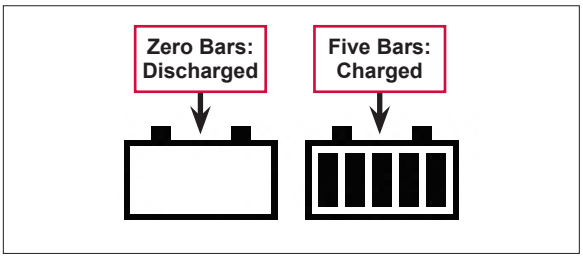
The broom adjustment LCD display shows the main broom position, the broom(s) selected for adjustment, the broom movement, the total run time and the battery charge/fuel level.



Battery Charge Indicator

The battery charge indicator shows the charge state of battery and will retain the charge state when the key is turned off. Five vertical bars indicates a fully-charged battery after a complete charging cycle. No bars indicates a discharged battery. Note that no bars will be shown if the machine is in the low-voltage cutout mode.

You can choose between two different low-voltage cutout thresholds depending on whether maintenance-free or standard batteries are being used.



Note: *The following percentages are based on* ***useable*** *battery capacity not total battery capacity. Therefore, 100% discharge = 80% of total battery capacity for standard wet cell batteries, or 70% of total battery capacity for maintenance-free batteries.*

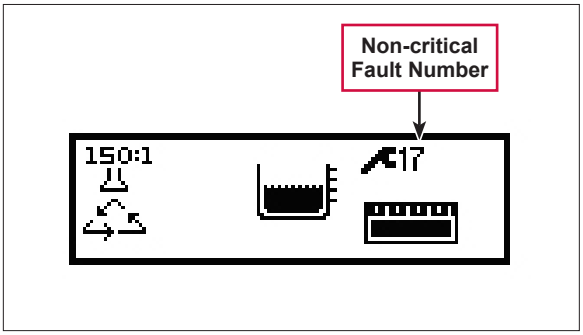
Battery Charge Indicator	Standard Battery	Alternate/Maintenance-free Battery
Reset to 5 bars	Low Voltage Cutout Reset	Low Voltage Cutout Reset
5 bars	Never below 35.9 V	Never below 35.9 V
4 bars	Never below 35.4 V	Never below 35.4 V
3 bars	Never below 34.4 V	Never below 34.4 V
2 bars	Never below 33.9 V	Never below 33.9 V
1 bar	Never below 32.2 V	Never below 33.3 V
0 bars	Never below 30.9 V	Never below 32.8 V
Not displayed	Low Voltage Cutout active	Low Voltage Cutout active

Fault, Caution and Warning Displays

Fault Displays

The system can detect overloads and short circuits on various hardware circuits, and detect system faults. There is no hardware detection of open circuits.

These non-critical faults detected by the main machine controller will be displayed on the display panel in the hour meter section. If more than one fault exists, the display will sequence through the fault codes at one-second intervals. Faults are display as a mechanical wrench icon followed by a two-digit code. Caution and warning displays take priority over non-critical fault displays.



Refer to the ***Electrical System*** section for a list of the non-critical fault codes.

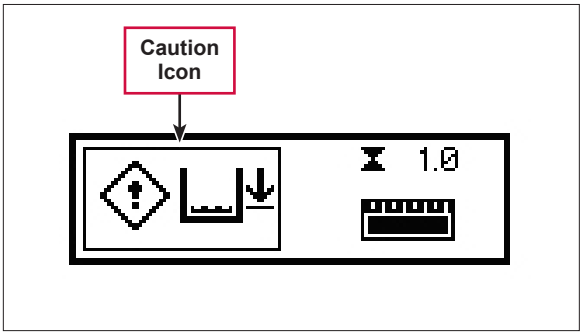
Caution Displays

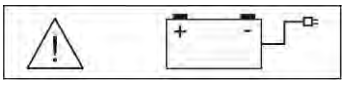
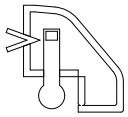
Any cautions detected by the main machine controller will be shown on the left side of the display. Only the fuel/battery level and hour meter indicators will remain.

Cautions icons are displayed as a non-inverse graphic.

If more than one caution and/or warning exists, the display will sequence through the active warnings and cautions at one-second intervals.

Refer to the table below for a list of the displayed cautions.

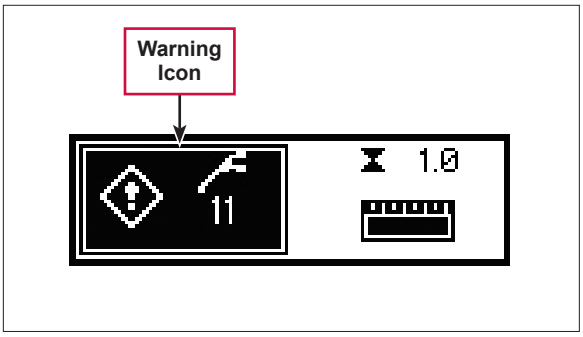


Caution	Condition	Display Icon
Low-voltage Cutout	The batteries need to be charged.	
Hopper Temperature	Hopper temperature has exceeded the operational temperature.	
Solution Level Low (Icon number 246)	Solution level has been low longer than 10 seconds	

Warning Displays

Any warnings detected by the main machine controller will be shown on the left side of the display. Only the fuel/battery level and hour meter indicators will remain. Warnings are displayed as inverse graphics. If more than one warning and/or caution exists, the display will sequence through the active warnings and cautions at one-second intervals.

Refer to the table below for a list of the displayed warnings.



Description	Display Icon
Critical fault warning	
Low battery warning	
Low fuel warning	
Parking brake warning	
Recovery tank full warning	
Engine temp hot	
Engine fault	
Engine Oil Pressure	

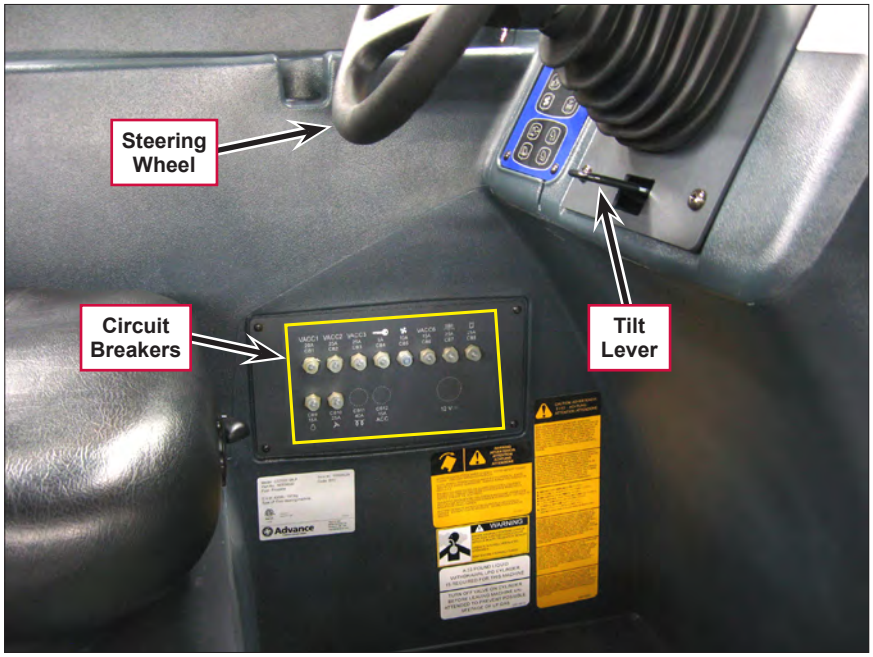
Steering Wheel

The steering system in the CS7000 is a “steer by wire” system that uses an encoder and brushless AC three-phase motor to transfer steering wheel input to the drive wheel.

Note that when the machine key switch is off, the **Steering Wheel** will “freewheel” with no turning resistance. Once the machine is powered-up, normal steering feel is restored.

The standard **Tilt Lever** allows the **Steering Wheel** to be tilted up and down to suit the Operator.

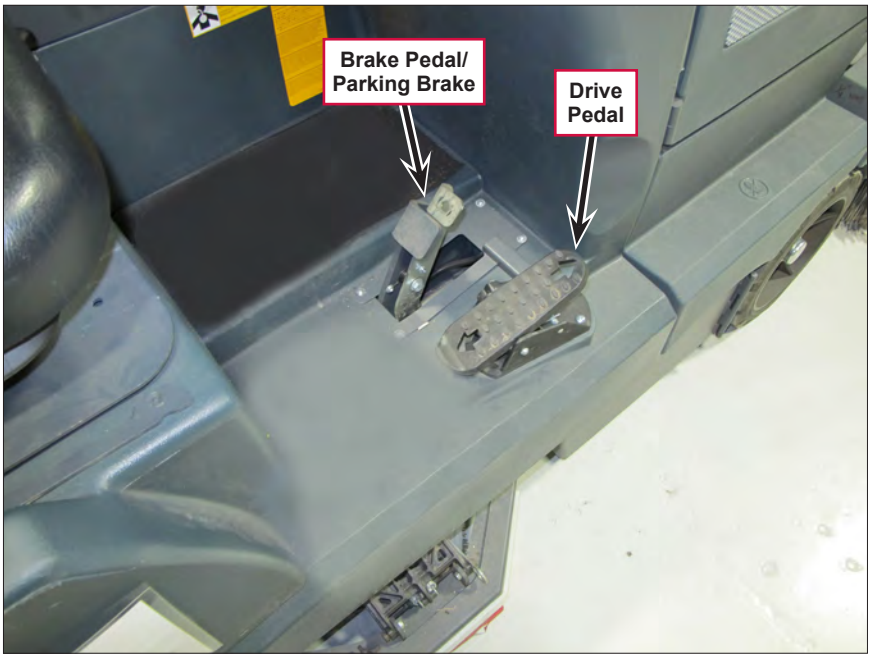
The **Circuit Breakers** are mounted on the panel adjacent to the Operator position.



Foot Pedals

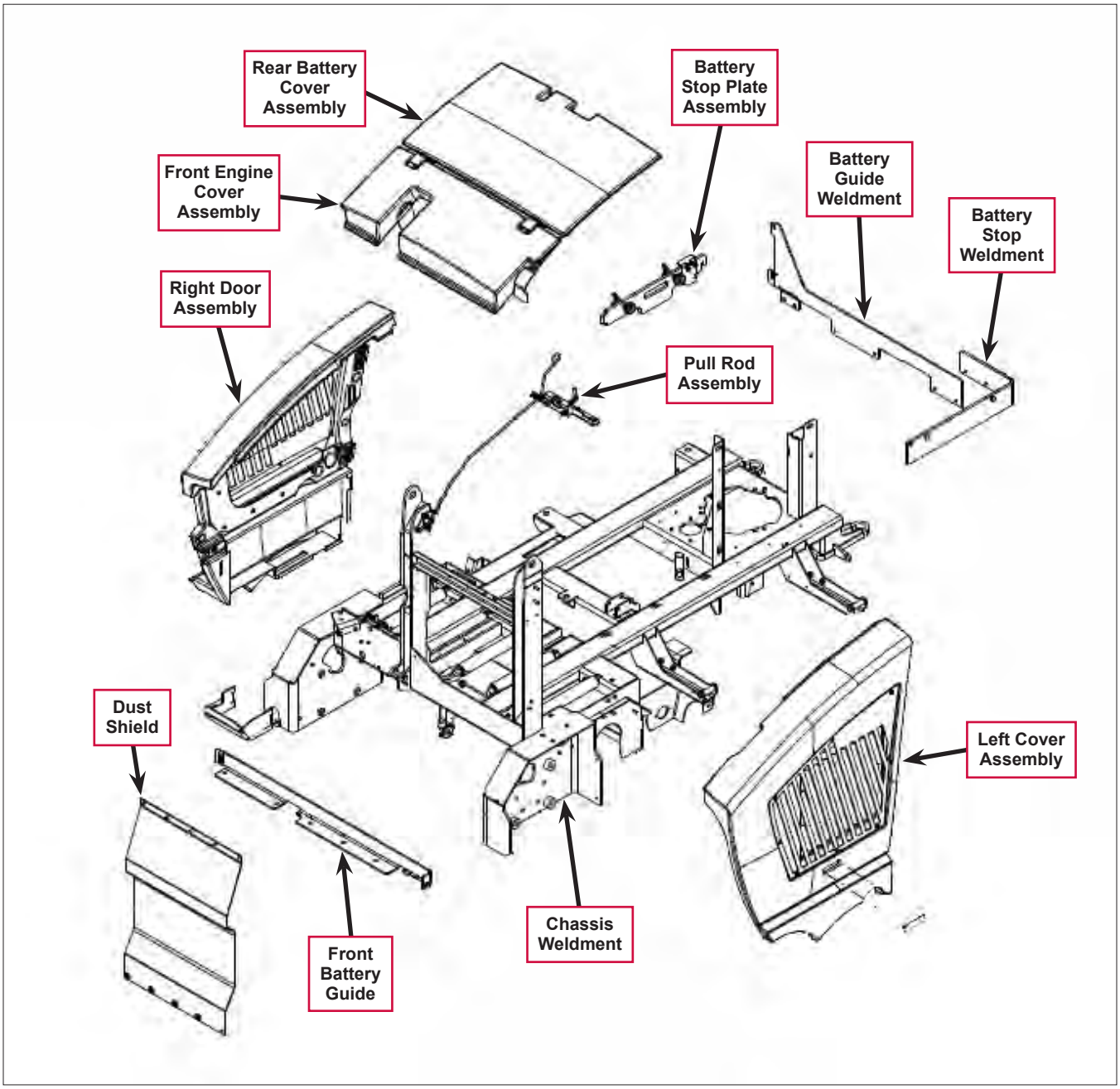
The **Brake Pedal/Parking Brake** brakes the machine, and locks in the applied position when used as a parking brake.

The **Drive Pedal** moves the machine forward and backward. Machine direction and speed are proportional to the **Drive Pedal** position.

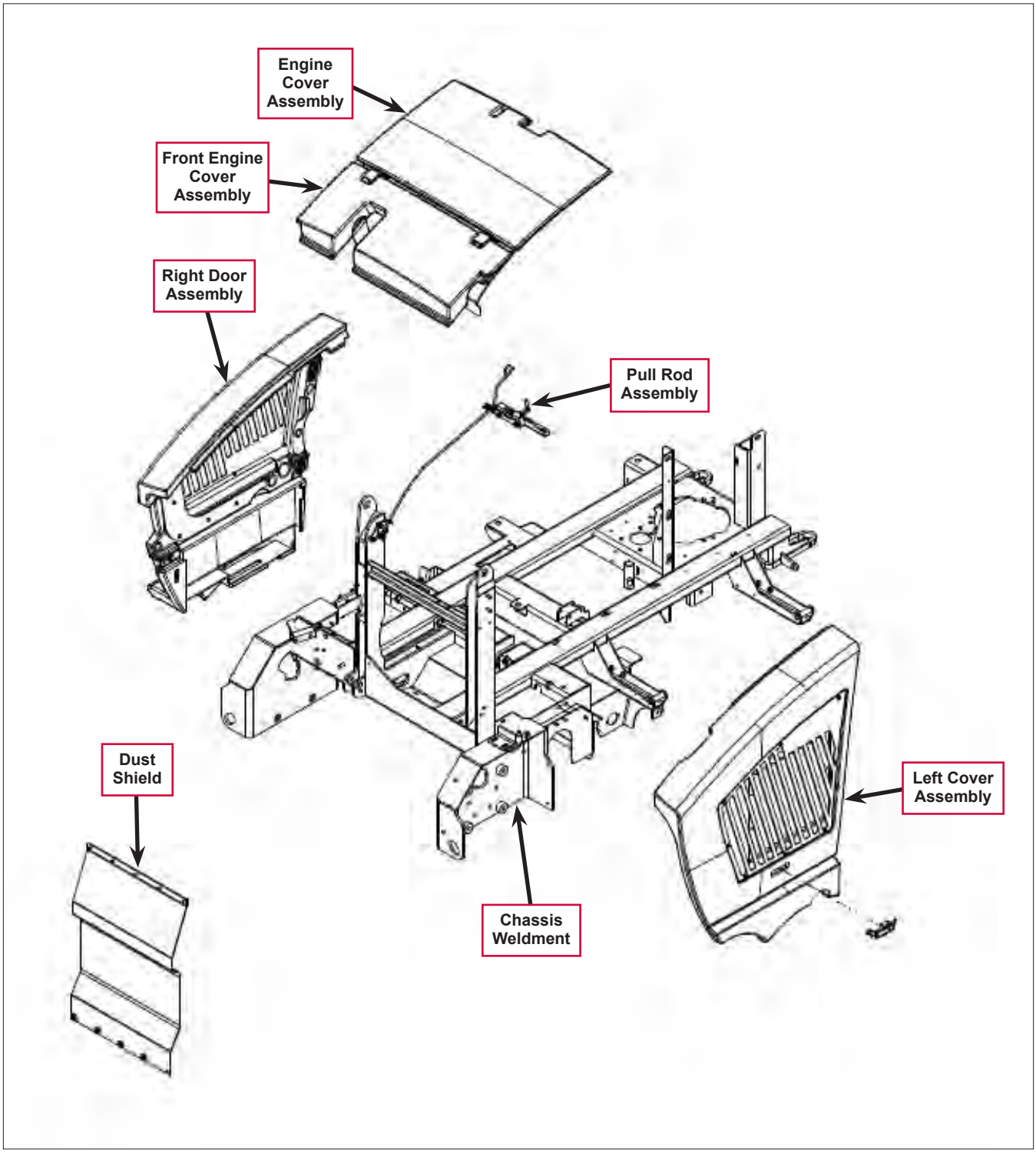


Chassis System

Component Locations - Battery Machine (major components)



Component Locations - LPG and Diesel Machine (major components)



Control System

Functional Description

The CS7000 has several “controllers” which operate various parts of the machine and which communicate with one another via a CAN bus. The CAN bus is like a “phone line” between all of the controllers that allow them to communicate with one another.

The main machine controller is responsible for operating all of the “cleaning functions” of the machine. All of the operator requests from the control panel are communicated to the main machine controller via the CAN bus. This greatly reduces the number of wires needed between the control panel and the main machine controller. The main machine controller tells the control panel what indicator lights to turn on and what to display in the LCD screen. The main machine controller monitors many circuits for overloads (shorts) and can set many diagnostic trouble codes that simplify troubleshooting.

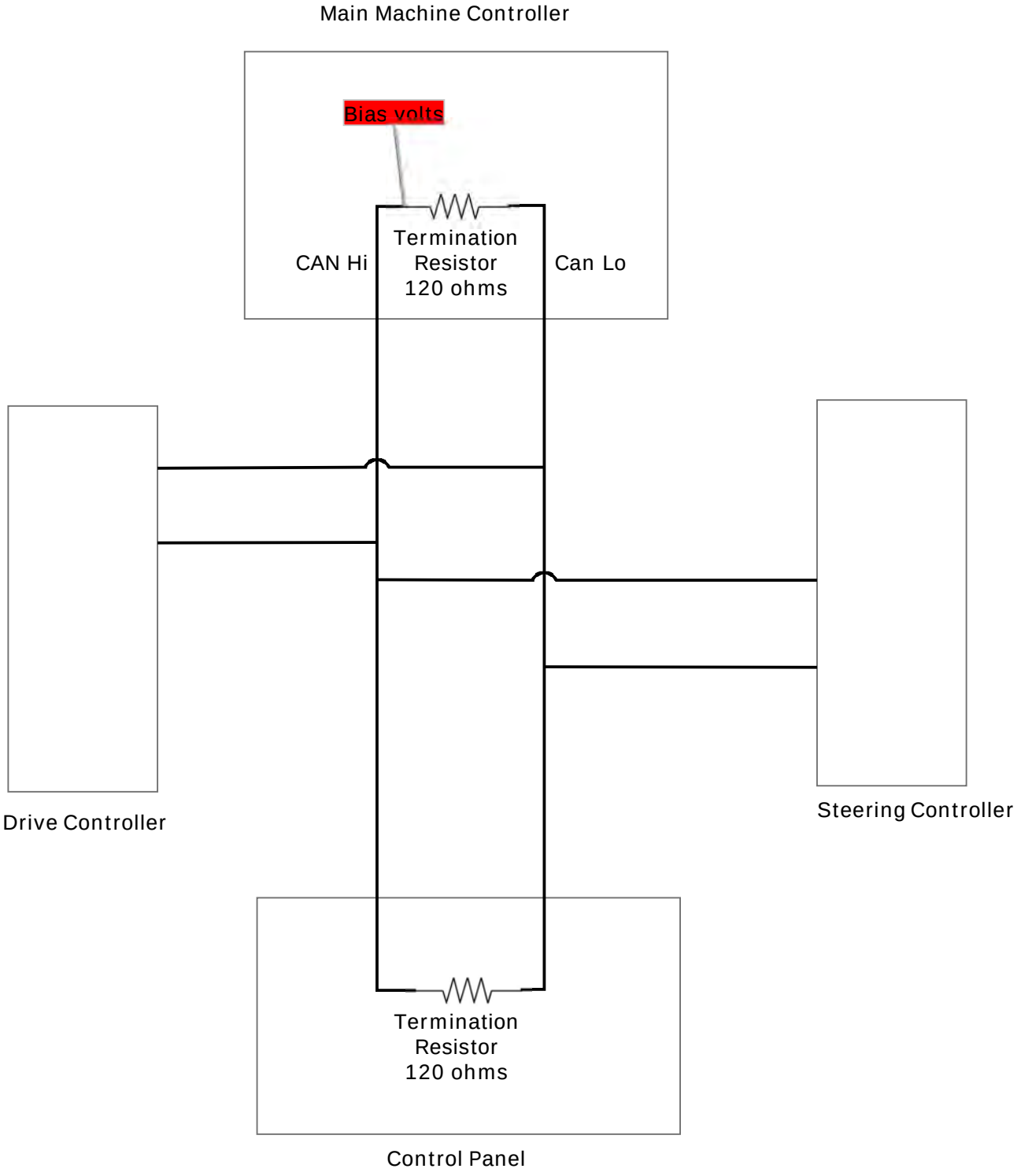
Main Machine Controller

The steering controller operates the steering system – See the ***Steering System*** chapter for more information.

The drive controller operates the wheel traction drive motor. – See the ***Wheel System, Traction*** chapter for more information.

CAN Bus Circuit

The main machine controller and the control panel are the two major players on the CAN Bus. The main machine controller provides a “bias voltage” on the CAN bus wires that the messages ride on. It also has a termination resistor inside it that connects the CAN Hi and CAN Lo circuits together. The control panel also has a termination resistor. These termination resistors are important for normal circuit operation. If one of them fails, communication will stop. The steering controller and the drive controller are both tied into the CAN Bus circuits but do not contain termination resistors.



CAN BUS message routing

The following outline describes what messages are communicated over the CAN Bus from one controller to another.

Control Panel

- Messages Sent
  - To Main Machine Controller
    - Operator switch inputs
  - To Drive Controller
    - None
  - To Steering Controller
    - None
- Messages Received
  - From Main Machine Controller
    - LED display instructions
    - LCD display instructions
    - Fault History for main controller, steering controller and drive controller
  - From Drive Controller
    - None
  - From Steering Controller
    - None

Main Machine Controller

- Messages Sent
  - To Control Panel
    - LED display instructions
    - LCD display instructions
    - Fault History for main controller, steering controller and drive controller
  - To Drive Controller
    - Push Mode On/Off
    - Transport Mode On/Off
    - Sweep System On/Off
    - Scrub System On/Off

    - Machine (Power Plant) Type - Battery/Engine (Hybrid)
    - Hopper Up/Down
  - To Steering Controller
    - None
- Messages Received
  - From Control Panel
    - Operator switch inputs
  - From Drive Controller
    - Drive System Fault Codes
    - Machine motion signal (Forward, Neutral, or Reverse)
  - From Steering Controller
    - Steering System Fault Codes

Drive Controller

- Messages Sent
  - To Main Machine Controller
    - Drive System Fault Codes
    - Machine motion signal (Forward, Neutral or Reverse)
    - Reverse signal
  - To Steering Controller
    - None
  - To Control Panel
    - None
- Messages Received
  - From Main Machine Controller
    - Push Mode On/Off
    - Transport Mode On/Off
    - Sweep System On/Off
    - Scrub System On/Off
    - Power Plant Type - Battery/Engine (Hybrid)
    - Hopper Up/Down
  - From Steering Controller
    - None

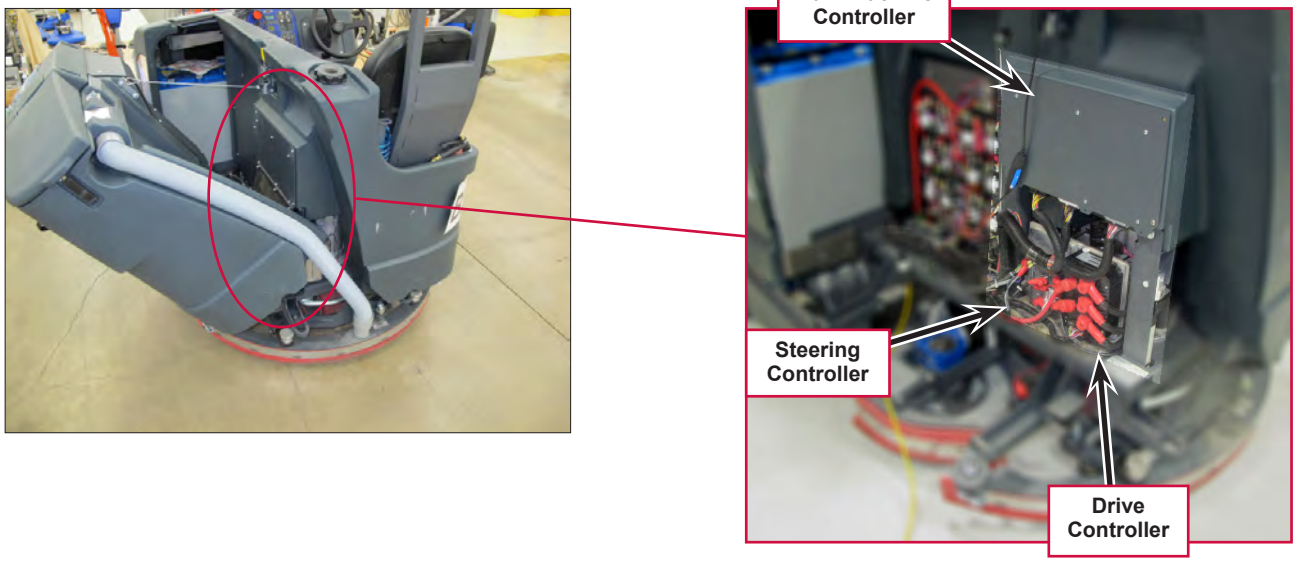
  - From Control Panel
    - None

Steering Controller

- Messages Sent
  - To Main Machine Controller
    - Steering System Faults
  - To Drive Controller
    - None
  - To Control Panel
    - None
- Messages Received
  - From Main Machine Controller
    - None
  - From Drive Controller
    - None
  - From Control Panel
    - None

Component Locations

- Main Machine Controller
- Control Panel
- Drive Controller
- Steering Controller



Caution! ***Do not pressure wash the control panel, main machine controller, steering controller, drive controller or any other electrical components.***

Troubleshooting

There are two important things you need to know about electrical diagnosis on the CS7000 machine. First, it is capable of setting fault codes that can help narrow down the possible causes. Second, there is a special "Service Mode" built into the machine that will help you diagnose electrical problems quickly. See the "***Fault Codes***" and "***Service Mode***" sections below for more information.

Fault Codes

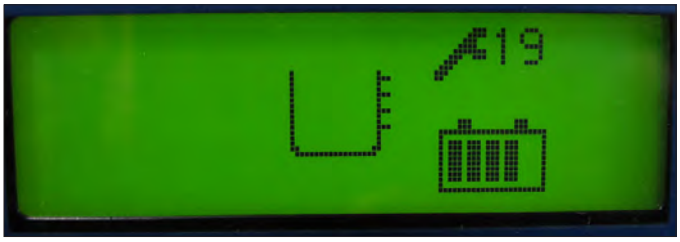
The main machine controller monitors every circuit it controls for overloads (excessive current draw). If it sees an overload it will set and display a fault code and shut the circuit down. For instance, if the side broom contactor coil becomes shorted and draws too much current, it will set and display a code 19 and shut down the side broom contactor control circuit. This means the side broom motors will not work and there will be a code 19 displayed. You should check the fault code table below to find out what "19" means. When you see that it means "Side Broom Contactor (K8) Winding Circuit Overload " that will help you narrow down the possible causes that you need to diagnose. Once the problem is corrected the fault code will no longer be displayed. However, it will remain in the fault code history.

Not all electrical problems will be accompanied by a fault code. The main machine controller does not set faults for open circuits or "not enough current draw". For instance, if the side broom motor contactor coil becomes open and draws no current, there will NOT be a code set for this condition. The side brooms will not work because of the open contactor coil but there will be no fault code. The main machine controller does not monitor every electrical circuit. For instance, it monitors the control side of the side broom contactor coil because it completes the circuit for the winding. It does not monitor the "contact" or "load" side of the contactor.

Any fault codes detected by the main machine controller will be displayed on the LCD display as they occur.

Critical faults are displayed like this code 50:

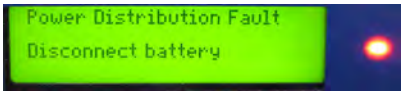
If more than one critical fault exists, the display will sequence through the active warnings and cautions at one-second intervals.



Non-critical faults are displayed like this code 19:

If more than one non-critical fault exists, the display will sequence through the fault codes and the hour meter at one-second intervals.

Fault Code Table (Main machine controller)

Fault #	Description	Setting Conditions	Consequences
None	Power Distribution Fault 	If the voltage of the 36v battery pack falls too low, the LCD will display this message. You need to charge the 36v battery pack.	
00	Auxiliary Contactor (K9) Winding Circuit Overload	Short circuit or > 4 Amps	
01	12 Volt Alternator is not charging	Battery voltage is less than 10 volts with the engine running	
02	Not used		
03	Not used		
04	Excessive Engine Temperature	Engine Temperature switch closed with the engine running.	Shut down engine
05	Low Engine Oil Pressure	Loss of engine run signal (Oil pressure switch open) with the key switch still on.	Shut down engine
06	Glow Plug Relay Overload		
07	42 Volt Alternator is not charging	< 37 volts for > 30 Seconds.	
08	Throttle 1 circuit overload	Current Overload	
09	Throttle 2 circuit overload	Current Overload	
10	Start Command circuit overload	> 18 Amps	
11	Ignition On circuit overload	> 18 Amps	
12	VACC1 circuit breaker tripped	Aux Contactor energized with no voltage at J2-13 VACC1	
13	VACC2 circuit breaker tripped	Aux Contactor energized with no voltage at J3-26 VACC2	
14	VACC3 circuit breaker tripped	Aux Contactor energized with no voltage at J3-34 VACC3a and J3-35 VACC3b	
15	VACC6 circuit breaker tripped	Key on with no voltage at J2-34 VACC6a and J2-35 VACC6b	
16	Scrub Deck Actuator (M11) Overload	> 7 Amps for 4 seconds or short circuit	Disables detergent, solution and scrub motors.
17	Main Broom Actuator (M21) Overload	> 6 Amps for 4 seconds or short circuit	Disables sweep functions.
18	Side Broom Actuator (M13) Overload	> 7 Amps for 4 seconds or short circuit	Disables side brooms.
19	Side Broom Contactor (K8) Winding Circuit Overload	> 4 Amps or short circuit	Disables side brooms.
20	Dust Control Contactor (K6) Winding Circuit Overload	> 4 Amps or short circuit	Disables dust control.
21	Left Brush Contactor (K1) Winding Circuit Overload	> 4 Amps or short circuit	Disables detergent, solution and scrub motors.
22	Center Brush Contactor (K2) Winding Circuit Overload	> 4 Amps or short circuit	Disables detergent, solution and scrub motors.

Fault #	Description	Setting Conditions	Consequences
23	Right Brush Contactor (K3) Winding Circuit Overload	> 4 Amps or short circuit	Disables detergent, solution and scrub motors.
24	Broom Contactor (K4) Winding Circuit Overload	> 4 Amps or short circuit	Disables sweep functions.
25	Hydraulic Pump1 Contactor (K4) Winding Circuit Overload	> 4 Amps or short circuit	
26	Hydraulic Pump2 Contactor (K4) Winding Circuit Overload	> 4 Amps or short circuit	
27	Dust Filter Plugged	Closed switch	Warning message only
28	Dump Door Actuator (M26) Overload	> 7 Amps for 4 seconds	Disables sweep functions and hopper door.
29	Hopper Over Temperature	Closed hopper temperature switch	Turns off the Dust Control motor, the Main Broom system, the Side Broom system, and closes the hopper dump door.
30	Shaker Motor (M14) Overload	> 20 Amps or short circuit	
31	Solution Pump (M19) or Extended Scrub Pump (M25) Overload	> 24 amps or short circuit	
32	High Pressure Washer Pump Electromagnetic Clutch Overload	> 18 Amps or short circuit	
33	Low Pressure Wash Pump (M23) Overload	> 20 Amps or short circuit	
34	Dust Guard Pump (M22) Overload	> 20 Amps or short circuit	
35	Solution Solenoid Valve (L1) Winding Overload	> 4 Amps or short circuit	Disables detergent, solution and scrub motors.
36	Chemical (Detergent) pump M17 overload	> 2.5 Amps or short circuit	Disables detergent.
37	Chemical (Detergent) pump M18 overload	> 2.5 Amps or short circuit	Disables detergent.
38	Vacuum Contactor (K5) Winding Circuit Overload	> 4 Amps or short circuit	Disables detergent, solution, scrub motors and recovery.
39	Squeegee Actuator (M12) Overload	> 5 Amps for 4 seconds or short circuit	Disables detergent, solution, scrub motors and recovery.
40	Right Front Turn Signal (LT4) Overload	> 3 Amps or short circuit	
41	Left Front Turn Signal (LT7) Overload	> 3 Amps or short circuit	
42	Right Rear Stop Turn Signal (LT11) Overload	> 6 Amps or short circuit	
43	Left Rear Stop Turn Signal (LT9) Overload	> 6 Amps or short circuit	
44	Head Lamp Circuit (LT2, LT3, LT8) Overload	Short circuit	

Fault #	Description	Setting Conditions	Consequences
45	Tail Lamp Circuit (LT5, LT6) Overload	> 3 Amps or short circuit	
46	Back-up Alarm (H1) Overload	> 4 Amps or short circuit	
47	Horn (H2) Overload	Short circuit	
48	Not used		
49	Low Voltage Cutout	< 30.8 V for Wet Acid Battery < 32.5 V for Gel Battery	Warning message and disable all sweep and scrub functions except recovery system
50	A Fault Has Been Set In The Steering Controller (A5)	Steering controller has communicated an emergency error message to the main machine controller (Retrieve the specific steering system code by using the hidden menu “configuration display” fault recall.)	Disables all sweep and scrub functions
51	A Fault Has Been Set In The Drive Controller (A2)	Drive controller has communicated a fault to the main machine controller (Retrieve the specific drive system code by using the hidden menu “configuration display” fault recall.)	Disables all sweep and scrub functions
52	Vacuum Motor Circuit (M6, M7) Overload	> 40 Amps for 20 seconds or short circuit	Disables detergent, solution, scrub motors and recovery.
53	Scrub Brush Motor Circuit (M2, M3, M4) Overload	> 75 Amps for 25 seconds or short circuit	Disables detergent, solution and scrub motors.
54	Main Broom Motor (M1) Overload Note: If this code is set after installing a new broom, adjust the broom height.	> 28 Amps for 30 seconds or short circuit	Disables sweep functions.
55	Broom Motor Current Sensor fault	Main broom motor contactor has been off more than 5 seconds but the broom motor current sensor is reporting > 6 A (2.6V).(Make sure the sensor is reading the correct wire(s))	Disables sweep functions
56	Brush Motors Current Sensor fault	Brush motor contactors have been off more than 5 seconds but the brush motor current sensor is reporting > 6 A (2.6V) (Make sure the sensor is reading the correct wire(s)).	Disables scrub functions
57	Vacuum Motor Current Sensor fault	Vacuum motor contactors have been off more than 5 seconds but the brush motor current sensor is reporting > 6 A (2.6V). (Make sure the sensor is reading the correct wire(s))	Disables scrub and recovery functions

Hidden Menus

The main machine controller supports a “hidden menu” which allows you to match the controller to the machine, set some user options and perform time saving service tests. There are three main hidden menus modes; Configuration Display, Configuration Menu and User Options Menu. A unique switch sequence is used to enter each mode.

Configuration Display

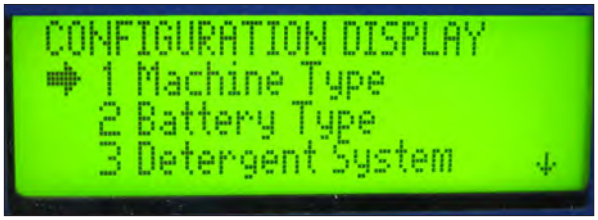
The configuration display mode is a “read only” mode that allows you to check how the main machine controller thinks the machine is equipped without running the risk of accidentally changing a value. It also allows you to check historical faults for the main machine controller, steering controller and drive controller.

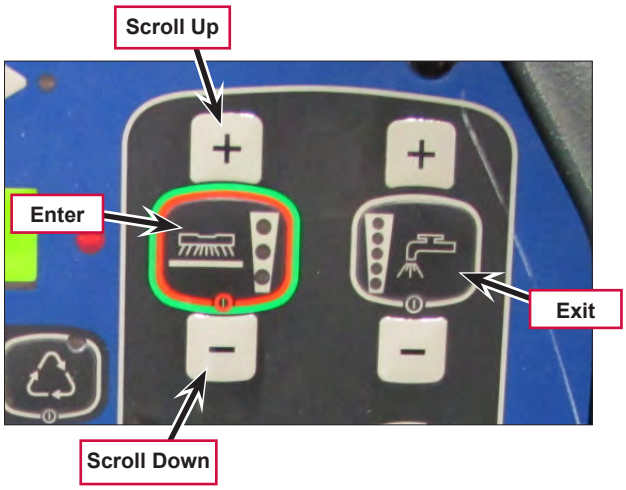
To enter the Configuration Display:

1. While Pressing and holding the hazard flasher switch, turn the key on.

2. Continue to hold the switch until the LCD reads “Configuration Display”, and then release the switch.

Once in the configuration display, you can scroll the “arrow cursor” through the menu using the scrub pressure increase and decrease buttons. To enter a menu selection, press the One-touch scrub switch. To exit and return to the configuration display mode, press the solution switch. To exit the hidden menu, turn the key switch off.





The Following is an outline of the menu:

- 1 Machine Type
- 2 Battery Type
- 3 Detergent System
- 4 EcoFlex System
- 5 Dust Guard system
- 6 Ex Scrub System
- 7 Back-Up Alarm
- 8 Signal Lights
- 9 Plugged Filter Kit
- 10 Hopper Temp Kit
- 11 Low Press Wash
- 12 High Press Wash
- 13 Scrub Motor Type
- 14 Display Screen
- 15 Light Option
- 16 Fault Recall
- 17 Haram Captor (Used to configure the machine for a special market)

Configuration Menu

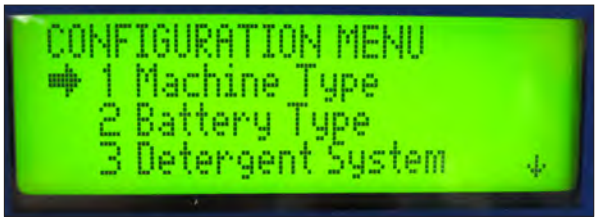
The configuration menu is a “read and write” mode that allows you to check and change the machine configuration values in order to tell the main machine controller how the machine is equipped. This “matches” the controller to the machine and must be done anytime a new main machine controller is installed.

Note The configuration menu also contains time saving service tests in the Service Menu. See the separate “Service Mode” section below for more details.

To enter the Configuration Menu:

1. While pressing and holding both of the turn signal switches, turn the key on.

2. Continue to hold the switches until the LCD reads “Configuration Menu”, and then release the switches.



Once in the configuration menu, you can scroll the “arrow cursor” through the menu using the scrub pressure increase and decrease buttons. To enter a menu selection, press the One-touch scrub switch. The arrow cursor points to the currently selected value. Scroll the cursor to the desired value and press the One-touch scrub switch to save the new value and return to the configuration menu. If you want to return to the configuration menu without saving a new value, press the solution switch. To exit the hidden menu, turn the key switch off .

The following is an outline of the menu. Default values are **bold** text.

- 1 Machine Type
  - 1 **Undefined** (When the machine type is “undefined” the control panel will display the configuration menu whenever the key is turned on.)
  - 2 Battery
  - 3 Diesel
  - 4 Propane
  - 5 Gas (Petrol)

- 2 Battery Type
  - 1. **Undefined** (When the machine type is "undefined" the control panel will display the configuration menu whenever the key is turned on.)
  - 1 Wet (Lead Acid)
  - 2 Sealed (gel)
- 3 Detergent System
  - 1 Installed?
    - 1 **Not Installed**
    - 2 Installed
  - Display Format
    - 1 **Ratio**
    - 2 Percentage
- 4 EcoFlex System
  - 1 **Not Installed**
  - 2 Installed
- 5 Dust Guard system
  - 1 **Not Installed**
  - 2 Installed
- 6 Ex Scrub System
  - 1 **Not Installed**
  - 2 Installed
- 7 Back-Up Alarm
  - 1 **Not Installed**
  - 2 Installed
- 8 Signal Lights
  - 1 **Not Installed**
  - 2 Installed
- 9 Plugged Filter Kit
  - 1 **Not Installed**
  - 2 Installed
- 10 Hopper Temp Kit
  - 1 **Not Installed**
  - 2 Installed
- 11 Low Press Wash
  - 1 **Not Installed**
  - 2 Installed
- 12 High Press Wash
  - 1 **Not Installed**
  - 2 Installed
- 13 Scrub Motor Type
  - 1 **Option 1** (Select Option 1)
  - 2 Option 2 (Do not select Option 2)
- 14 Display Screen
  - 1 **US Display**
  - 2 Global Display
- 15 Light Option (Head Lights)
  - 1 **Standard Light**
  - 2 LED Light

Caution! ***Selecting "LED Light" on a machine with standard incandescent head lights can cause the bulbs to blow out and shatter.***

- 16 Service Menu
  - 1 Service Mode (Must turn key off to exit service mode)
    - Example:
      - Batt 36.839V
      - Pedal 2.58V Neutral
  - 2 Battery Level
    - E.G.
      - 2 Sealed (gel)
      - 37.710 V
      - Level 5
  - 3 Solution Reading
    - E.G.

        - Reading 0x67
        - Level 3
    - 4 Fault Detection
        - 1 Enabled
        - 2 Disabled
    - 5 About
        - Example:
            - CS7000
            - 56510353_Rev_F
    - 6 Shaker Continuous
        - 1 **No**
        - 2 Yes
    - 7 Actuator Sequence (For engineering use)
- 17 Restore Defaults (Resets all Configuration Menu selections and User Options selections to default values)
    - Are you sure? (One-touch scrub switch = “Yes”. Solution switch= “No”.
- 18 Haram Captor
    - 1 No (Use for all CS7000 models)
    - 2 Yes (Use for special market Haram Captor model to customize solution level processing and scrub pressures)

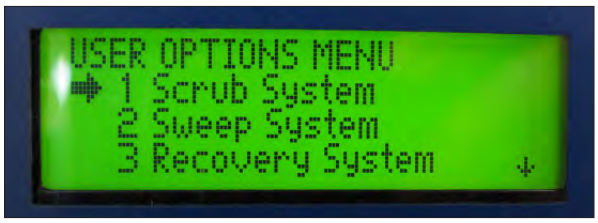
User Options Menu

The user options menu allows you to customize certain machine functions according to machine operator preferences.

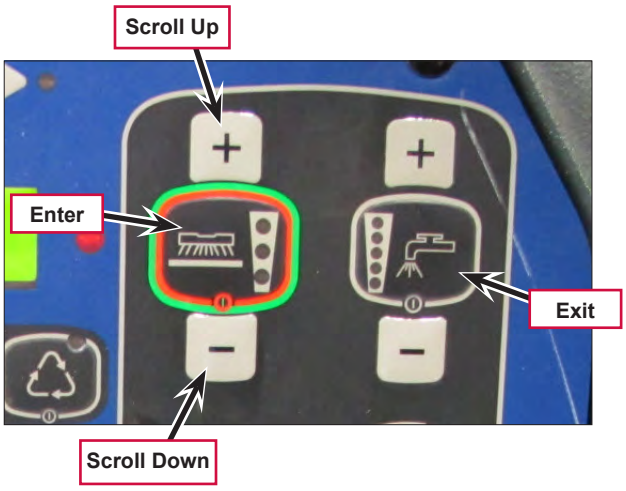
To enter the User Options Menu:

1. While pressing and holding the One-touch scrub switch AND the solution switch, turn the key on.

2. Continue to hold the switches until the LCD reads “User Options Menu”, and then release the switches.



Once in the user options menu, you can scroll through the menu using the scrub pressure increase and decrease buttons. To enter a menu selection, press the One-touch scrub switch. To exit and return to the User options menu mode, press the solution switch. To make a selection and return, press the One-touch scrub switch. To exit the hidden menu, turn the key switch off.



The following is an outline of the User Options Menu Default values are **bold** text or noted.

- 1 Scrub System
  - 1 Scrub Mode 1st Use - The default scrub mode used the first time after power up. After first time, mode is last used.
    - 1 **Light** - The scrub mode will default to the Light setting when activated. (DEFAULT)
    - 2 Heavy - The scrub mode will default to the Heavy setting when activated.
    - 3 Extreme - The scrub mode will default to the Extreme setting when activated.
  - 2 Detergent Start Up - Determines if the detergent system will be activated when the scrub is turned on.
    - 1 Off - always disabled when the scrub system is activated.
    - 2 On - always enabled when the scrub system is activated.
    - 3 **Last State** - returned to state when the scrub system was last on.
  - 3 Maximum Mode - The maximum scrub mode that the operator can select.

- 1 Light - The only available scrub mode will be the Light setting.
- 2 Heavy - The Light and Heavy scrub mode will be available.
- 3 **Extreme** - All scrub modes will be available.

– 4 Light Scrub Mode - The light scrub pressure, solution rate and detergent rate can be programmed depending on its application where high solution rate is needed with light scrub pressure or low solution rate with heavy scrub pressure.

- 1 Scrub Pressure -
  - RANGE: 1-MIN, 2-MED, 3-MAX
  - DEFAULT: 1-MIN
- 2 Solution Flow
  - RANGE: Off,1 – 5
  - DEFAULT: 1

– 5 Heavy Scrub Mode - The heavy scrub pressure, solution rate and detergent rate can be programmed depending on its application where a higher solution rate is need with heavy scrub pressure or low solution rate with heavy scrub pressure.

- 1 Scrub Pressure
  - RANGE: 1-MIN, 2-MED, 3-MAX
  - DEFAULT: 2-MED
- 2 Solution Flow
  - RANGE: 1 – 5
  - DEFAULT: 2

– 6 Extreme Scrub Mode - The extreme scrub pressure, solution rate and detergent rate can be programmed depending on its application where a higher solution rate is need with extreme scrub pressure or low solution rate with extreme scrub pressure.

- 1 Scrub Pressure
  - RANGE: 1-MIN, 2-MED, 3-MAX
  - DEFAULT: 3 - MAX
- 2 Solution Flow
  - RANGE: 1 – 5
  - DEFAULT: 3

– 7 Neutral Off Delay - This determines how long before the brushes are stopped after returning to neutral

- RANGE: 0.5 – 5 seconds
- INCREMENT: 0.5 seconds
- DEFAULT: 0.5 seconds

– 8 Scrub Down Time - When activated the scrub is lowered for a period of time before the control starts

moving the deck based on the current of the brush motors.

- RANGE: 1 – 3 seconds
- INCREMENT: 0.1 seconds
- DEFAULT: 2 seconds

– 9 Solution In Reverse - Determines whether solution will flow when the machine backs up.

- 1 Off (This is default)
- 2 On

• 2 Sweep System

– 1 Sweep Off Timeout - This determines how long before the dust control and brooms are stopped after returning to neutral

- RANGE: 0.5 – 5 seconds
- INCREMENT: 0.5 seconds
- DEFAULT: 0.5 seconds

– 2 Shaker Duration - Determines how long the shaker will run once it is activated.

- RANGE: 10 – 40 seconds
- INCREMENT: 1 second
- DEFAULT: 15 seconds

• 3 Recovery System -

– 1 Sqg Down Time - Sets the time to extend the squeegee when lowering it into the active position.

- RANGE: 1 – 4 seconds
- INCREMENT: 0.25 seconds
- DEFAULT: 4 seconds

– 2 Sqg Up Time - (Lift in Reverse) Sets the time to retract the squeegee. When backing up with the recovery system active, the control unit will automatically raise the squeegee to prevent dragging on the floor.

- RANGE: 1 – 4 seconds
- INCREMENT: 0.25 seconds
- DEFAULT: 2 seconds

– 3 Vacuum Off Delay - Sets the timeout for the vacuum during the recovery power down sequence.

- RANGE: 12 - 20 seconds
- INCREMENT: 1 second
- DEFAULT: 12 seconds

– 4 Recovery Mode - Sets when the recovery system begins the power down sequence (only when the Scrub System is being shut off). This is only affective when the system is operating when turned off.

- 1 **Normal** - starts immediately

- 2 Neutral - waits for the machine to return to neutral

– 5 Detect RTF (Recovery Tank Full) The machine is equipped with a feature that will automatically shut off the vacuum and scrub systems and display a recovery tank full icon on the control panel display when the recovery tank becomes full. If problems are encountered with the vacuum shutoff feature, such as the vacuum shutting off even when the recovery tank is not full, this feature can be turned off.

- 1 No - Do not detect recovery tank full
- 2 **Yes** - Detect recovery tank full

• 4 User Lockouts

– 1 Spd Control Adjust (Battery only) - Blocks the user from increasing the speed when scrubbing or sweeping.

- **Unlocked**
- Locked

– 2 Scrub Mode Adjust - Blocks the user from changing scrub mode settings.

- 1 **Unlocked**
- 2 Detergent - Prevents the user from changing detergent settings.
- 3 Detergent & Sol - Prevents the user from changing detergent and solution settings.

• 5 Extended Scrub System

– Start Up State

- Off – always disabled when the scrub system is activated.
- On – always enabled when the scrub system is activated.
- **Last State** – returned to state when the scrub system was last on.

• 6 Low Voltage cutout - The batteries are monitored. Once the voltage drops below the cutout level, various systems are shut down to prevent depleting the batteries. The batteries must be charged above a reset level before normal operation is allowed. The LVC clearing will set the batteries to full. This setting adjusts the cutout and reset voltages. The description is on a “per cell” basis. There are 18 cells.

– 1 **1.75V, 2.15V**

– 2 1.75V, 2.09V

– 3 1.83V, 2.09V

• 7 Reduced Speed Mode - Cougar can be programmed to automatically limit the maximum travel speed while scrubbing only, either scrubbing or sweeping, or always.

– **When Scrub** - The maximum travel speed will be reduced while scrubbing.

– When Scrub&Sweep - The maximum travel speed will be reduced when scrubbing or sweeping.

– Always – The maximum speed is the Scrubbing speed setting.

• 8 Engine Idle Delay - This setting adjusts how many seconds to delay before returning the engine RPM to idle after the machine stops moving.

• idle.

  - RANGE: 10 – 250 seconds
  - INCREMENT: 1 second
  - DEFAULT: 20 seconds
- 9 Back-up Alarm
  - 1 Off - never on
  - 2 **Reverse Only** - Only on in reverse
  - 3 Fwd & Reverse - on when in motion
  - 4 Fwd, Rev & Hopper - on when motion or the hopper is lifted
- 10 Headlights
  - 1 **Normal** - User controls with key switch (DEFAULT)
  - 2 Always On - On when machine is running. Key switch allow momentary off.
- 11 Broom Lift in Rev
  - 1 No
  - 2 Yes
- 12 Maximum Speed
  - RANGE: 20% - 100%
  - INCREMENT: 20%
  - DEFAULT: 100%

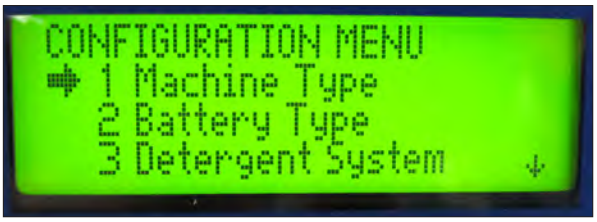
Service Mode

The service mode makes some diagnostic testing easier. Some outputs (like the scrub brush motors) are only turned on when other conditions are met, such as when the machine is moving. It can be difficult to check for voltage to the scrub brush motors while the machine is moving. Also, if voltage is not present, it leaves in question what other conditions may not have been met yet. The service mode solves these problems for you by allowing you to request that the controller ignore all other conditions and directly turn on the scrub brush motors (or other output loads).

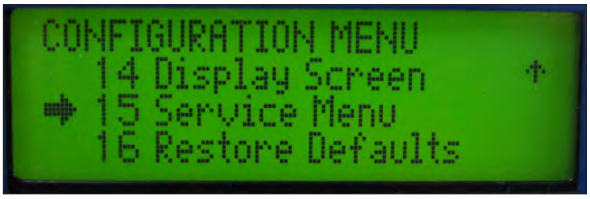
Enter the service mode through the “Configuration Menu”.

1. While holding down both the left and right turn signal switches, turn the key switch on.

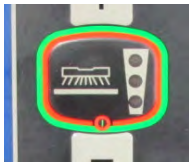
2. Continue to hold the switches down until the “Configuration Menu” is displayed, then release the switches.



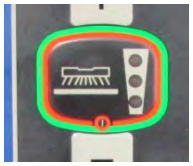
3. Press and release the scrub pressure decrease button several times to scroll down the menu list until the arrow cursor is aligned with the “15 Service Menu” selection.

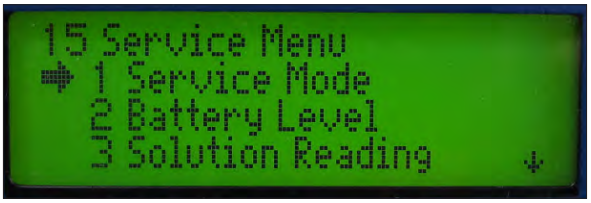


4. Press the One-touch scrub switch to enter the service menu.



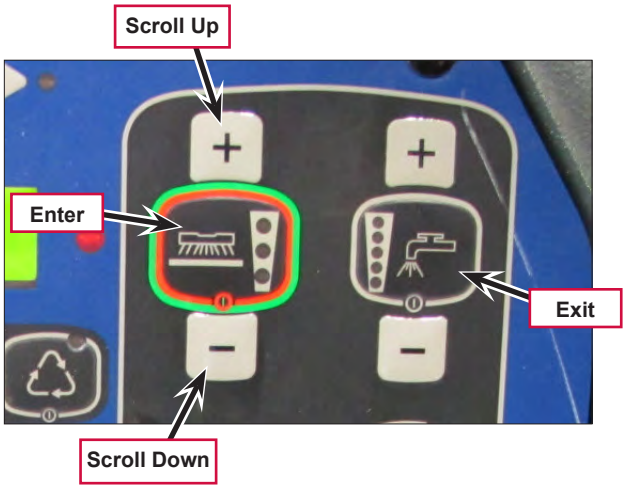
5. With the arrow cursor aligned with “Service Mode”, press the One-touch scrub switch to enter the mode.





“Service Mode” will be displayed at the top of the LCD followed by battery voltage, drive pedal position sensor voltage, drive mode (Reverse, Neutral or Forward) and any current main machine controller faults..

Once in the service mode, you will be able to turn various electrical loads on and off through the control panel buttons. Some loads are toggled on and off by a single button press, while others are only on when the button is held down. **To exit the service mode: Turn the Key Switch off.**

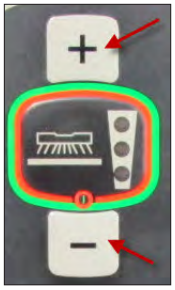


To Operate:

Scrub Motors

Pressing the One-touch scrub switch once will turn all of the brush motors on (energize all contactors) and illuminate the button LEDs. The scrub pressure indicators will be on while the brush motors are on. Pressing the switch again will turn the brush motors off (de-energize the contactors).

Scrub Deck Actuator



Pressing the scrub pressure increase button will move the deck down. Each press and release will extend the actuator motor a little. Holding the button down will run the motor in the extend direction.

Pressing the scrub pressure decrease button will move the deck up. Each press will retract the motor a little. Holding the button down will run the motor in the retract direction.

Vacuum Motor and Squeegee Actuator

Pressing the vacuum/wand switch once will move the squeegee down (extend actuator), turn on the vacuum motors (energize relay) and illuminate the vacuum/wand indicator. Pressing the button again will move the squeegee up (retract actuator) and turn the vacuum motor off (de-energize relay).

Solution Valve (and pump if equipped)

Pressing the solution switch once turns on the solution valve to allow solution to flow. At least one of the solution flow indicator lights will come on. If the model is equipped with a solution pump, the pump will run at the flow rate indicated by the solution flow indicators. While the solution system is “on” you can increase or decrease the solution flow rate by pressing the solution flow increase and decrease buttons.

Detergent Pumps

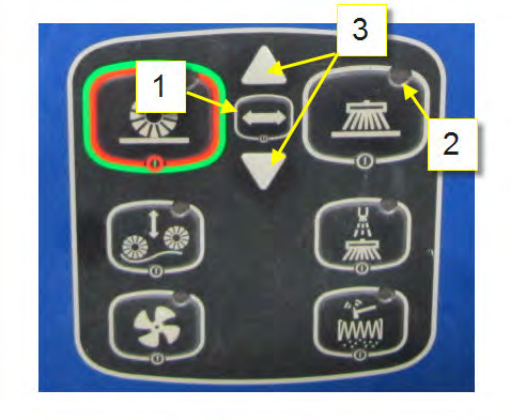
Pressing the detergent switch once will cycle the detergent pumps on and off (if equipped) and illuminate the detergent indicator. You should be able to hear and feel the pumps click. The detergent ratio will be displayed in the LCD while the pump is running. Pressing the detergent switch again will turn off the pump.

Side Broom Motors

Pressing the side broom switch once will turn on the side broom motors (energize relay). The side broom button on indicator will illuminate. Pressing the button again will turn off the side brooms (de-energize relay).

Side Broom Actuator

Press the broom select switch (1) until the side broom on indicator (2) flashes slowly. Then press and hold the down arrow (3) to move the side brooms down. Press and hold the up arrow (3) to move the side brooms up.

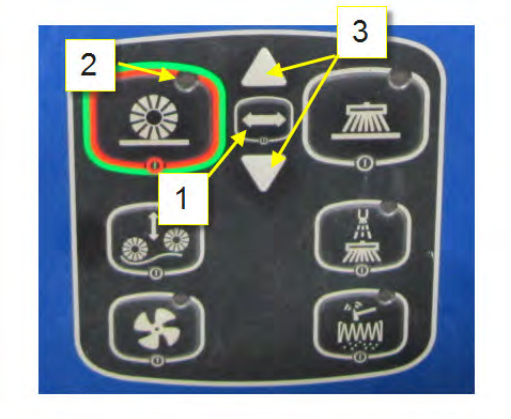


Main Broom Motors

Pressing the One-touch sweep switch once will turn on the main broom motor (energize relay). The main broom on indicator will illuminate. Pressing the button again will turn off the motor (de-energize relay).

Main Broom Actuator

Press the broom adjustment selection button (1) until the main broom button indicator (2) flashes slowly. Then press and hold the down arrow (3) to move the main broom down. Press and hold the up arrow (3)to move the main broom up.



Shaker Motor

Pressing the filter shaker switch once will turn on the shaker motor and illuminate the filter shaker on indicator. Pressing the button again will turn off the motor.

Dust Guard Pump

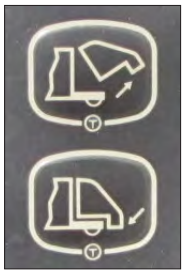
Pressing the dust guard spray switch will turn on the dust guard pump and illuminate the dust guard on indicator. Pressing the switch again will turn off the pump.

Dust Control Motor

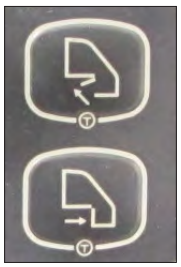
Pressing the dust control fan switch will turn on the dust control motor (energize relay) and illuminate the dust control fan on indicator. Pressing the switch again will turn off the motor (de-energize relay).

Hopper Hydraulic Pump

Pressing and holding either the hopper raise or lower buttons will energize the relays to operate the pump.



Hopper Door Motor



Pressing and holding either the hopper door open or close buttons will move the door in the appropriate direction until the limit is reached. This is different than normal operation where a single press opens or closes the door completely.

Extended Scrub Pump

Pressing the extended scrub switch will turn on the extended scrub pump (and solution pump and solution valve if equipped) and illuminate the extended scrub indicator. Pressing the switch again will turn off the pump.

High Pressure Wash Pump

Pressing the High-pressure wand switch will turn on high pressure pump electromagnetic clutch and illuminate the high pressure wand indicator. Pressing the button again will turn off the pump.

Troubleshooting

Control Panel LEDs all stay lit - CAN Bus problems

If communication on the CAN bus fails, the operator may or may not notice anything. If they notice anything it will likely be that the control panel powers up when the key is turned on but all of the LEDs remain lit and there is no response to pushing any switch on the control panel.

Control panel appearance with CAN Bus failure

If this happens, start by checking to see if either the steering controller or drive controller is causing the problem by unplugging their low current connectors one at a time. If normal operation is restored after unplugging one of the controllers, that controller is corrupting the communication on the CAN Bus and should be replaced.

Next inspect the CAN Bus wires for shorts to ground, shorts to power or short to one another.

- Turn the key off and unplug the control panel, the main machine controller, steering controller and the drive controller connectors.
- At the main machine controller connector, check for the presence of voltage on each of the CAN Bus wires. If there is voltage (example 12v or 36v), the wire is shorted to a voltage source. Find and correct the short circuit.
- Using an ohmmeter, check for continuity between each of the CAN Bus wires and battery negative. If continuity is found, there is a short to ground (battery negative). Find and correct the short circuit.
- Using an ohmmeter, check the continuity of all of the wires from the main machine controller connector to each of the other connectors. If any wire does not have continuity there is an open. Find and correct the open circuit.

If the wiring is not the problem, check to see if the main machine controller is capable of providing the "bias" voltage on the circuit.

- Make sure the key is off and then plug in only the main machine controller.
- Turn the key on and then check the voltage on each of the CAN Bus wires at the Control Panel Connector. If there is no voltage, the main machine controller is defective because it is not providing bias voltage.

If the voltage on the CAN Hi (YEL) wire is approximately 3.3v and the voltage on the CAN Low (GRN) wire is approximately 1.8v, the main machine controller is providing the bias voltage. This indicates that the control panel is the source of the problem and needs to be replaced.

Removal and Installation

Main Machine Controller

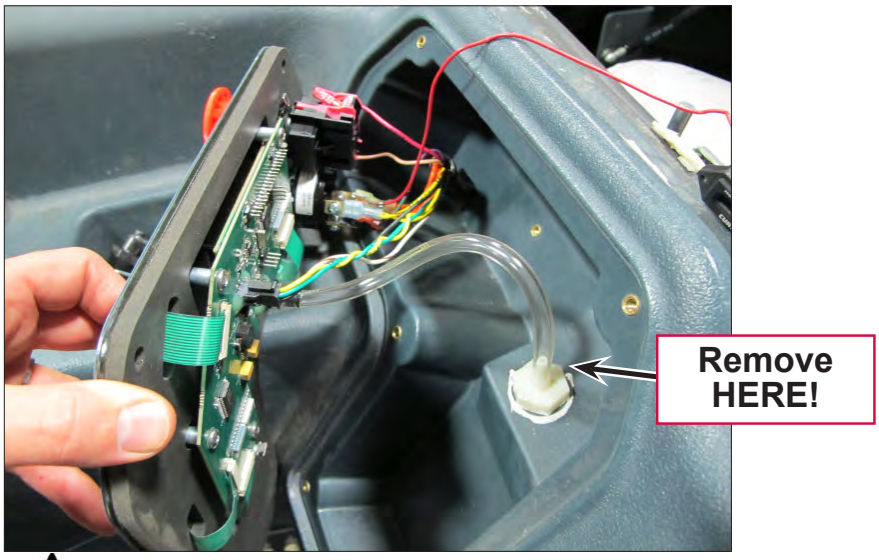
1. Turn the key switch off and disconnect the main battery connector.
2. Remove the recovery tank.
3. Remove the control panel plate to frame fasteners
4. Lay the controller and wiring down. Disconnect the 3 electrical connectors. Note, the connectors on the harness are color coded and keyed to match the connectors on the controller.
5. Reassemble in reverse order.

Note. To avoid repeat controller failure, when replacing a controller, you should check all of the load devices it controls to make sure none of them are shorted.

6. Turn the key on. You will automatically be taken to the Configuration Menu on the Control Panel LCD.
   a. You must select the Machine Type and the Battery Type before the machine will be allowed to operate.
   b. You must also go through the remaining menu selections and inform the new main machine controller how the machine is equipped, so that it can properly manage all of the machine's features.
   c. Adjust the Main Broom and Side Broom height.

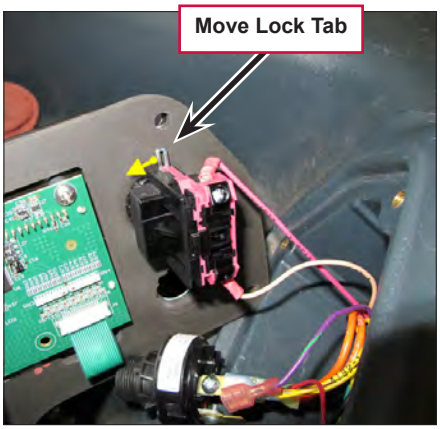
Control Panel

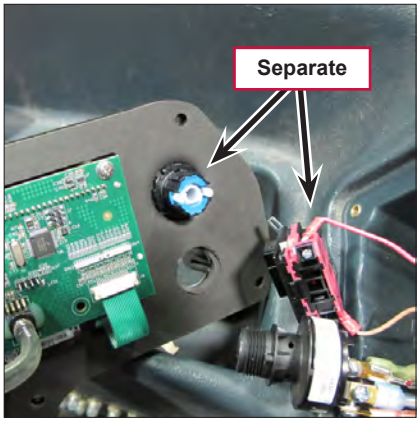
1. Empty the solution tank. (The tank must be empty upon reassembly for the solution level indicator to work properly).
2. Disconnect the main battery connector.
3. Remove key and key switch retaining nut.
4. Remove the 6 control panel mounting screws.
5. Pull control panel forward and remove the clear hose from the white fitting on the solution tank.



DO NOT REMOVE THE HOSE FROM THE CIRCUIT BOARD!

6. Disconnect the electrical connector.
7. Separate the key switch from the board.
8. Move the lock tab for the emergency stop switch and separate the back half of the switch from the control panel.





9. Before reassembly, make sure the solution tank is empty. The pressure sensor used to measure the tank liquid level depends on the tank being empty when the hose is reconnected.
10. Reassemble in reverse order.

Specifications

Shop Measurements – Main Machine Controller

The following tables contain some "real world" shop voltage measurements to help you recognize what "normal" looks like. All voltage values were measured with the black (Negative) voltmeter lead connected to the main battery negative unless otherwise specified.

J2 Connector (White)

J2 Pin	Wire	Circuit Description	Value/Condition
1	091 ORN/YEL	Left Front Turn Lamp	10.3v when off 0.02v when on
2	094 ORN/BLU	Left Rear Stop/Turn Lamp	11.1v when off 0.01v when on
3	098 YEL/RED	Right Front Turn Lamp	10.3v when off 0.02v when on
4	101 YEL/GRN	Right Rear Stop/Turn Lamp	11.1v when off 0.01v when on
5	107 TAN/BLK	Tail Lamps	5.1v when off 0.01v when on
6	064 BLK/YEL	Dust Control Motor Contactor Grounds to energize	0.07v when energized 37v when not energized
7	119 BRN/WHT	Detergent Pump (M17)	Pulsed voltage is too fast for useful measurement value
8	080 WHT/GRN	Squeegee Actuator Motor	37v at rest or when going down 0.04 going up
9	078 BLU/BRN	Squeegee Actuator Motor	37v at rest or when going up 0.01v going down
10	132 RED/GRN	Scrub Deck Actuator Motor	37v at rest or when going down 0.15v going up
11	135 YEL/GRA	Scrub Deck Actuator Motor	37v at rest or when going up 19v going down
12	162 BLK	Battery Negative	0.001v scrub and sweep systems running
13	057 VIO	VACC 1 Power supply from Aux Contactor	0v Key Off 37v Key On (Aux Contactor energized)
14	051 BLK/ORN	Auxiliary Contactor Grounds to energize	0.07v when energized 37v when not energized
15	163 BRN/BLK	Side Broom Motor Contactor Grounds to energize	0.08v when energized
16	063 GRN/GRA	Main Broom Motor Contactor Grounds to energize	0.08v when energized
17	045 BLU	Vacuum Motor Contactor Grounds to energize	0.08v when energized
18	150 BLK/RED	Shaker Motor PWM ground	10.6v shaker motor running

J2 Pin	Wire	Circuit Description	Value/Condition
19	116 WHT/YEL	Detergent Pump (M17)	Pulsed voltage is too fast for useful measurement value
20	157 YEL/ORN	Solution Solenoid Valve Grounds to energize	0.1v when energized
21	160 BLU/VIO	Detergent Pump (M18)	Pulsed voltage is too fast for useful measurement value
22	167 BLK/YEL	Lamps Common	12v key on
23	169 BRN	Head Lamps and Curb Lamp PWM ground to turn on lights	37v key on and lights off 33.7v key on headlights on
24	039 ORN/RED	Hydraulic Pump Motor Contactor (K12) Grounds to energize	0.08v when energized (Hopper Down)
25	047 YEL/BLU	Left Brush Motor Contactor Grounds to energize	0.08v when energized
26	015 WHT/VIO	Center Brush Motor Contactor Grounds to energize	0.08v when energized
27	061 GRA/RED	Right Brush Motor Contactor Grounds to energize	0.08v when energized
28	038 BLU/ORN	Hydraulic Pump Motor Contactor (K11) Grounds to energize	0.08v when energized (Hopper Up)
29	---		
30	---		
31	---		
32	221 GRA/BLIU	Detergent Pump (M18)	Pulsed voltage is too fast for useful measurement value
33	---		
34	054 BLK/WHT	VACC6a Power supply from Aux Relay	0v Key Off 37v Key On (Aux Relay energized)
35	053 BLK/WHT	VACC6b Power supply from Aux Relay	0v Key Off 37v Key On (Aux Relay energized)

J3 Connector (Gray)

J3 Pin	Wire	Circuit Description	Value/Condition
1	042 VIO/ORN	Extended Scrub Pump PWM ground	Not measured
2	093 RED/YEL	Solution Control Pump PWM ground	37v no flow 27v minimum flow rate 5.6v maximum flow rate
3	030 BRN/WHT	Main Broom Actuator Reversing polarity driver	37v at rest or when moving down 5.4v when moving up
4	031 RED/VIO	Main Broom Actuator Reversing polarity driver	37v at rest or when moving up 5.3v when moving down
5	106 GRA/VIO	Side Broom Actuator Reversing polarity driver	37v at rest or when moving down 0.08v when moving up

J3 Pin	Wire	Circuit Description	Value/Condition
6	111 BRN/GRN	Dump Door Actuator Reversing polarity driver	37v at rest or closing 0.07v opening
7	115 RED/GRA	Dump Door Actuator Reversing polarity driver	37v at rest or opening 0.03v closing
8	118 WHT/ORN	High Pressure Pump Clutch Coil	0.003v Off 11.9v On (Service Mode)
9	123 PINK	Ignition On Output 12v out to engine system	0v key off 12.1v key on
10	129 BLU/PINK	Start Output 12v out to starter	0v key off 10.9v cranking (12v if starter disabled)
11	131 GRA/ORN	Throttle 2 Output	0.03v or 13.8v (depending on throttle request)
12	134 GRA/BLU	Throttle 1 Output	0.03v or 13.8v (depending on throttle request)
13	137 BRN/RED	Dust Guard Control (Pump and Valve) Grounds to turn both on	0.05v when energizing valve and running pump
14	139 VIO/BRN	Horn Ground to turn on	0.24v when sounding horn
15	144 BLK	Battery Negative	0.006v with scrub, sweep and vacuum motors free running
16	142 BLK	Battery Negative	0.006v with scrub, sweep and vacuum motors free running
17	250 GRN/ORN	Side Broom Actuator Reversing polarity driver	37v at rest or when moving up 0.05v when moving down
18	149 BLK	Battery Negative	0.006v with scrub, sweep and vacuum motors free running
19	154 BLK	Battery Negative	0.006v with scrub, sweep and vacuum motors free running
20	156 BLK	Battery Negative	0.006v with scrub, sweep and vacuum motors free running
21	159 BLK	Battery Negative	0.006v with scrub, sweep and vacuum motors free running
22	---		
23	059 VOI/RED	12V supply Power supply from starting battery	0v key off 12.1v key on
24	171 GRN/WHT	Low Pressure Pump	37v (Not “Installed”) 0v (“Installed”)
25	---		
26	058 GRA	VACC2 Power supply from Aux Contactor	0v Key Off 37v Key On (Aux Relay energized)
27	076 GRN/BRN	Backup Alarm	Not measured
28	---		
29	166 BLK	Battery Negative	0.006v with scrub, sweep and vacuum motors free running
30	---		

J3 Pin	Wire	Circuit Description	Value/Condition
31	---		
32	049 ORN/BLK	Glow Plug Output 12v out to energize relay	11.6v when glow plug relay energized 0v key off or after time out period
33	---		
34	056 GRA/BLK	VACC3a Power supply from Aux Contactor	0v Key Off 37v Key On (Aux Relay energized)
35	055 GRA/BLK	VACC3b Power supply from Aux Contactor	0v Key Off 37v Key On (Aux Relay energized)

J7 Connector (Black)

J7 Pin	Wire	Circuit Description	Value/Condition
1	092 GRN/BLU	Interlock Switch Input	37v when all interlock switches closed 0v otherwise
2	095 GRN	CAN Bus Low	2.448v
3	099 YEL	CAN Bus High	2.52v
4	102 GRA	Run Signal Output	14v when engine running 0v key off, on or cranking (starter disabled)
5	108 GRA/YEL	Engine Coolant Temperature	4.99v normal temp
6	112 TAN/WHT	Fuel Level Sender	3.3v open circuit 1.8v float at bottom 0.37v float at top
7	117 YEL/RED	Low LP Pressure Switch	5.0v when open
8	---		
9	---		
10	130 WHT/BRN	+12v Power out to Control Panel	12.07v
11	133 BLK	B- (Ground) for Control Panel	0.002v
12	050 YEL/BRN	Suppression Diode	37v key on
13	141 ORN	Key Switch On Input	37v key on 0v key off
14	046 RED/BLK	Hopper Interlock Switch	0.0v full down position 4.8v otherwise
15	035 GRA/YEL	Extended Scrub Level Switch	4.8v (machine not equipped)
16	143 WHT/GRA	Dust Control Filter Switch	4.8v (machine not equipped)
17	145 ORN/GRA	Brake Switch	0v brake pedal at rest position 4.8v brake pedal pressed (not at rest)
18	151 YEL/VIO		
19	155 VIO/GRN	Key Switch Start Input	37v key in start 0v key off or on
20	---		
21	161 RED/ORN	Scrub Deck Retract Limit Switch	0.0v full up position 4.8v otherwise

J7 Pin	Wire	Circuit Description	Value/Condition
22	168 ORN/RED	Hopper Dump Door Extend Limit Switch	0.0v full closed position 4.8v otherwise
23	170 YEL/WHT	Hopper Dump Door Retract Limit Switch	0.0v wide open position 4.8v otherwise
24	172 BLU/YEL	+5v Power out to Current Sensors	4.97v
25	174 VIO/WHT	B- Ground for Current Sensors	0.002v
26	---		
27	178 BRN	Brush Motor Current Sense	2.49v at rest (no current) 2.86v free-running at 22 amps
28	---		
29	184 RED/WHT	Vacuum Motor Current Sense	2.49v at rest (no current) 3.01v Vac running, cover open at 28 amps
30	---		
31	215 ORN/BLU	Broom Motor Current Sense	2.49v at rest (no current) 2.71v free-running at 12 amps
32	---		
33	032 BLU/ BLK	POT High Power supply for Main Broom Actuator Position Sensor	3.304v (plugged in or unplugged)
34	033 GRA/GRN	Wiper Main Broom Actuator Position Sensor input	0.002v full up position 3.02v bottom of travel (9.93v when open)
35	034 TAN/RED	POT Low B- for Main Broom Actuator Position Sensor	0.002v

Dust Control/DustGuard™ Systems

Functional Description

Overview

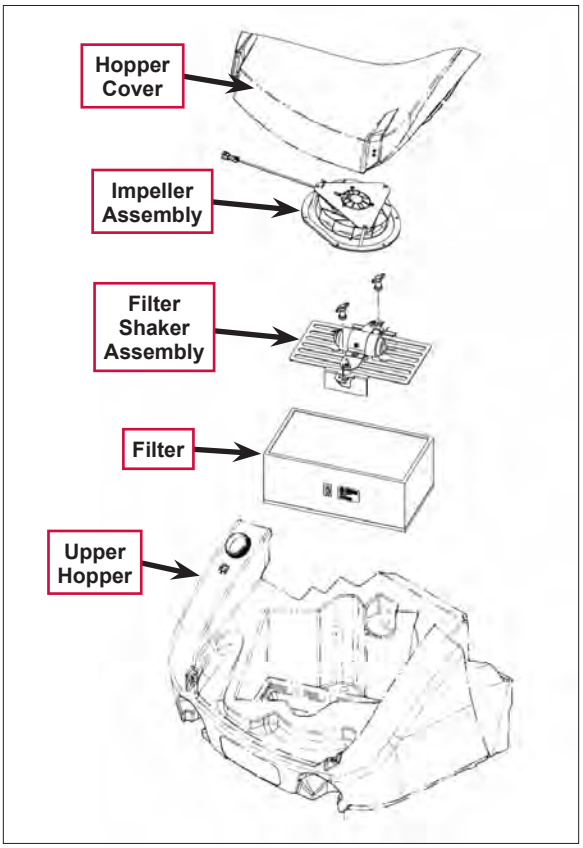
The dust control system pulls air through the hopper and through a filter to trap the dust from the hopper. The optional DustGuard™ system sprays a fine stream of water in front of each side broom to minimize the dust created by the main broom.

Dust Control System

The **Impeller Assembly**, mounted in the **Hopper Cover**, pulls air from the **Upper Hopper** through the **Filter** which traps the dust generated by the sweep system. The **Impeller Assembly** exhausts the filtered air through vents in the **Hopper Cover**.

An optional dust control filter switch will shut off the vacuum motor in the **Impeller Assembly** if the vacuum on the clean side of the filter gets too high as a result of a clogged **Filter**. When the switch is activated, the LCD will display an icon to the operator.

The removable **Filter Shaker Assembly** vibrates the **Filter** when the filter shaker switch is pressed to shake large particles from the input side of the **Filter** back into the hopper. This reduces **Filter** maintenance and helps maintain adequate airflow through the **Filter**. The **Filter Shaker Assembly** will automatically switch on when the sweep system is turned off.

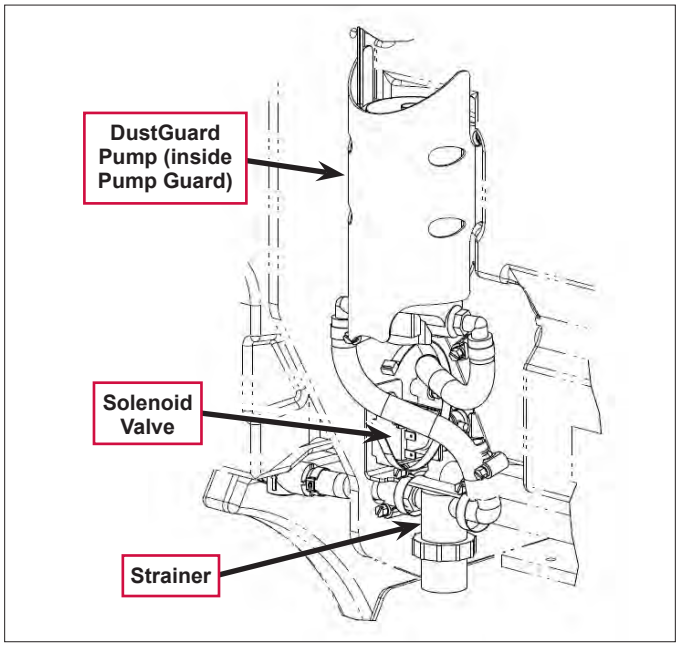


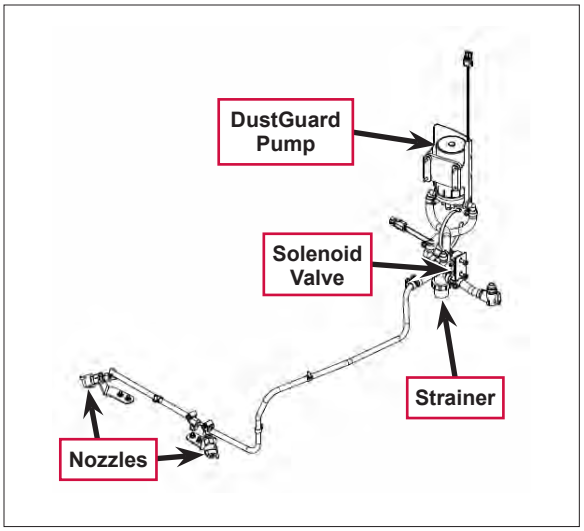
DustGuard™ Spray System (optional)

The **DustGuard Pump** pumps water from a separate reservoir in the upper hopper to **Nozzles** on the front of the machine. The **Nozzles** direct a fine stream of water onto the floor in front of the side brooms to help reduce the dust generated by the brooms.

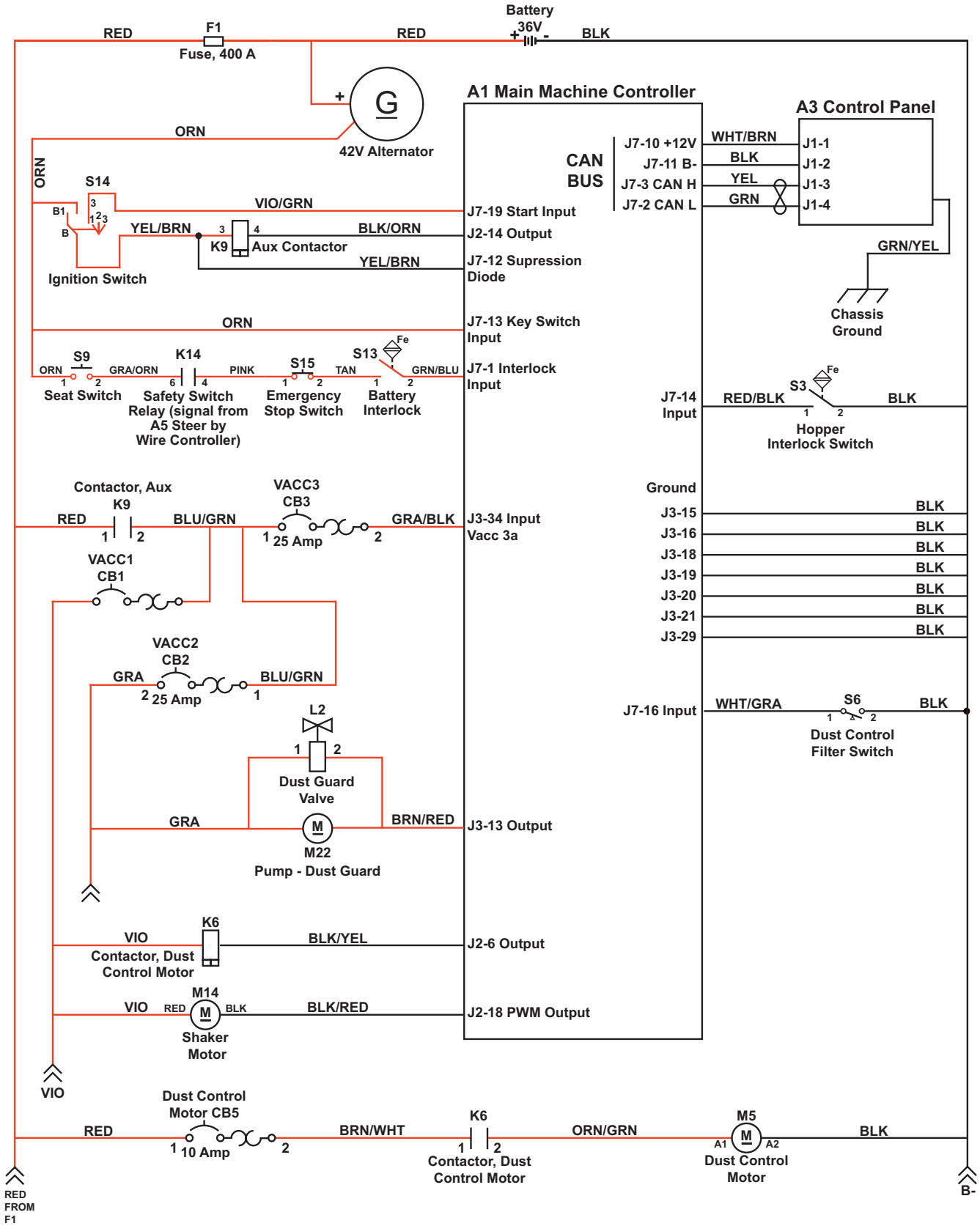
The DustGuard™ **Solenoid Valve** opens to allow water flow from the **DustGuard Pump** to the **Nozzles** when the power to the **DustGuard Pump** switches on. A removable **Strainer** is installed in the water line upstream of the **DustGuard Pump** and **Solenoid Valve**. Removable strainers are also located inside of the **Nozzle** assemblies.

When installed, the DustGuard™ spray system will turn on automatically when the main broom/ sweep system is turned on.





DustGuard™ System Wiring Diagram



Circuit Description

The following conditions must be met for the DustGuard™ system to operate:

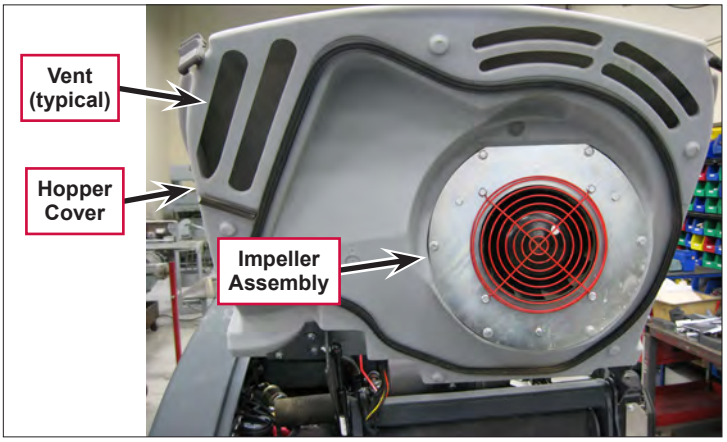
- The DustGuard™ system must be installed in the configuration menu.
- There must be positive voltage to the **J7-1 Interlock Input**. For this to happen:
  - The **Seat Switch S9** must be closed.
  - The **Safety Relay K14** on the **Steer By Wire Controller A5** must energize the coil to close the **Safety Relay K14** contactor.
  - The **Emergency Stop Switch S15** must be closed.
  - The **Battery Interlock S13** must be closed (battery machines) or jumpered (Diesel and LPG machines).
- The **400-amp Fuse F1** must be closed to provide positive voltage from the **Battery** to the load side of **Auxiliary Contactor K9**, and to the 10-amp circuit breaker **CB5**.
- The **Ignition Switch S14** must be closed to provide positive voltage to the **Auxiliary Contactor K9** coil. The **J2-14 Output** on the **A1 Main Machine Controller** provides ground to the **Auxiliary Contactor K9** coil when the **Ignition Switch S14** provides an input to the **Key Switch Input J7-12**.
- The **Auxiliary Contactor K9** must be closed to provide positive voltage to circuit breaker **VACC2/CB2**.
- Circuit breaker **VACC1/CB1** must closed to provide positive voltage to the **Dust Control Motor Contactor K6** coil and the **Shaker Motor M14**.
- The **J2-6 Output** provides the negative ground to the **Dust Control Motor Contactor K6** coil under the following conditions:
  - If the hopper is down:
    - The **A1 Main Machine Controller** must receive a signal from the **A3 Control Panel** via the **CAN BUS** that the operator has pressed the DustGuard™ spray switch (blue LED on).
    - The **A1 Main Machine Controller** must receive a signal from the **A2 Drive Controller** via the **CAN BUS** that the machine is moving forward or backward.
  - If the hopper is up, the **A1 Main Machine Controller** must receive a signal from the **A3 Control Panel** via the **CAN BUS** that the operator has pressed the DustGuard™ spray switch. Note that the seat switch does not have to be closed.
- Circuit breaker **CB5** must closed to provide positive voltage to the load side of **Dust Control Motor Contactor K6**.
- **Dust Control Motor Contactor K6** must be closed to provide positive voltage to the **Dust Control Motor M5**.
- **Dust Control Motor M5** must be connected to battery ground.
- Circuit breaker **VACC2/CB2** must closed to provide positive voltage to the **DustGuard Valve L2** and the **DustGuard Pump M22**.
- The **J3-13 Output** provides the negative ground to the **DustGuard Valve L2** and the **DustGuard Pump M22** under the following conditions:
  - The **A1 Main Machine Controller** must receive a signal from the **A3 Control Panel** via the **CAN BUS** that the operator has pressed the DustGuard™ spray switch (blue LED on).
  - The **A1 Main Machine Controller** must receive a signal from the **A2 Drive Controller** via the **CAN BUS** that the machine is moving forward.

- The **J2-18 Output** provides the negative ground to the **Shaker Motor M14** under the following conditions:
  - If the hopper is down and the DustGuard™ system is enabled, the **A1 Main Machine Controller** will switch on the **Shaker Motor M14** automatically for preset duration when the sweep system is switched off.
  - If the hopper is up, the **A1 Main Machine Controller** must receive a signal from the **A3 Operator Interface Panel** via the **CAN BUS** that the operator has pressed the filter shaker switch (blue LED on).

Component Locations

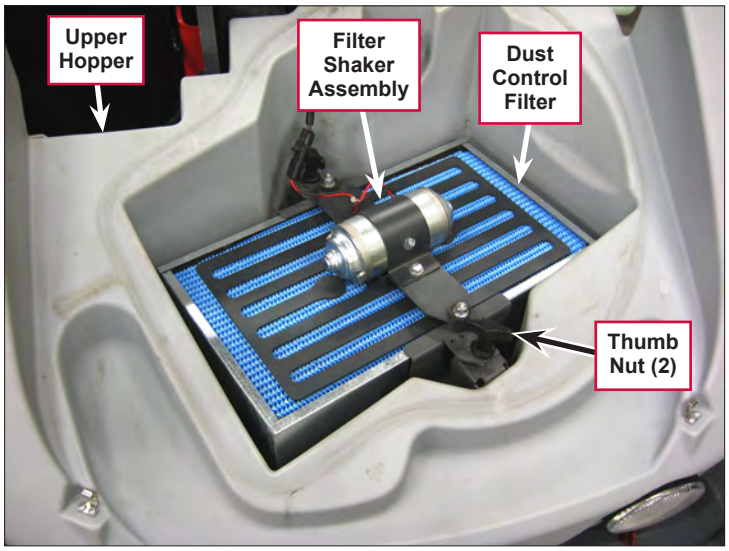
Impeller and Filter System

The **Impeller Assembly** houses the dust control vacuum motor and is mounted in the **Hopper Cover**. The **Impeller Assembly** pulls air from the hopper through the filter. The filtered air is exhausted through **Vents** in the front of the **Hopper Cover**.



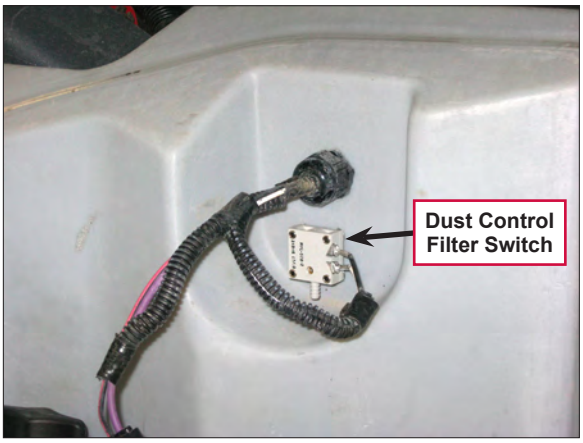
The rectangular **Dust Control Filter** seals against the **Upper Hopper** and is held in place by the **Filter Shaker Assembly**.

The electric motor in the **Filter Shaker Assembly** drives two eccentric weights to vibrate or "shake" the **Dust Control Filter** to dislodge dust and allow it to drop down into the hopper. Two **Thumb Nuts** secure the **Filter Shaker Assembly** and **Dust Control Filter** to the **Upper Hopper**.

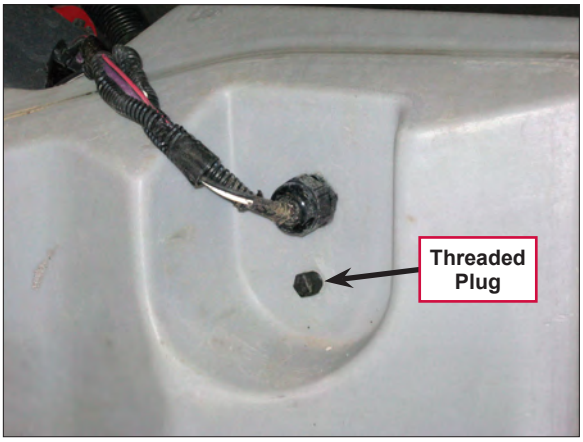


Dust Control Filter Switch

The optional **Dust Control Filter Switch** is mounted above the **Filter Shaker Assembly** on the **Upper Hopper**. The **Dust Control Filter Switch** will close and generate a warning if the hopper vacuum gets too high, indicating a plugged **Dust Control Filter**. Note that the **Dust Control Filter Switch** is factory-set to close at 2" of water, 0.147" Hg or 0.072 psi.

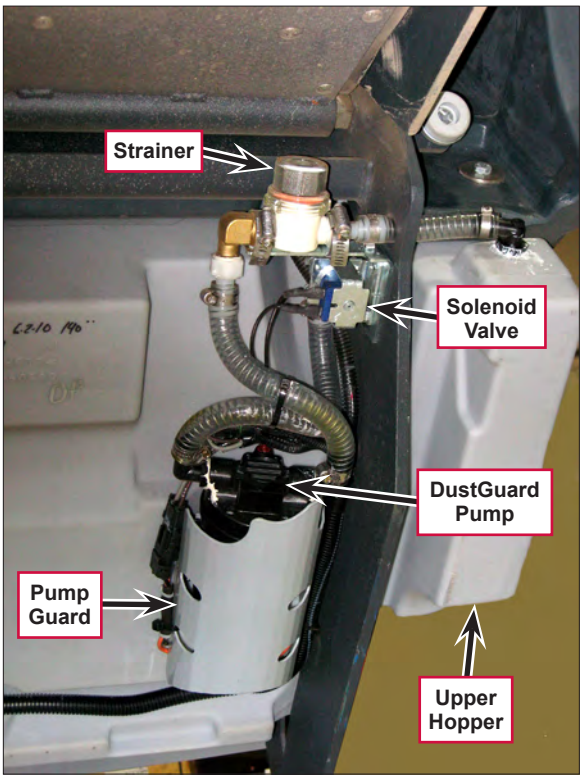


If the dust control filter switch is not installed in the hopper, there will be a **Threaded Plug** installed in the switch hole.



DustGuard™ Spray System

The **DustGuard Pump** is mounted on the **Upper Hopper** and is protected by the **Pump Guard**. The **Strainer** screens the incoming water upstream of the **DustGuard Pump**. The **Solenoid Valve**, downstream of the **DustGuard Pump**, opens to allow water flow to the nozzles when the power to the **DustGuard Pump** is switched on.



The **Spray Nozzles** are mounted on the front of the machine and spray an oval pattern of water mist across the width of each side broom.

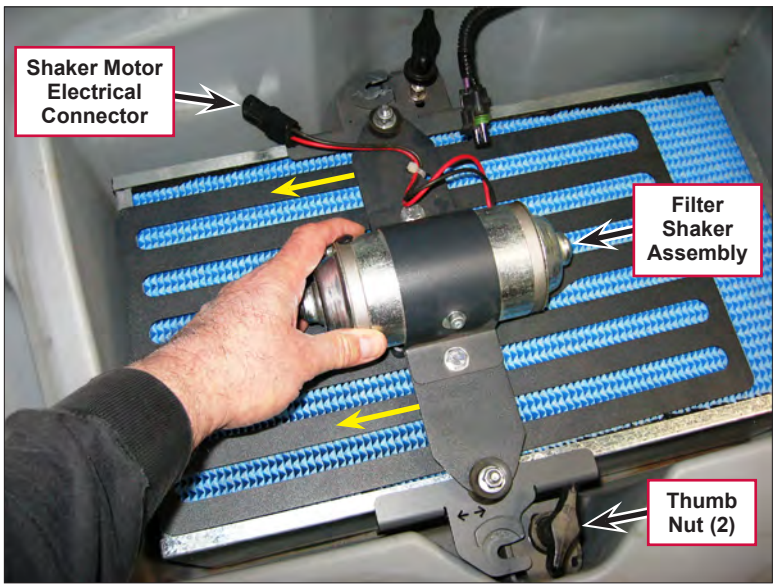
Maintenance and Adjustments

Warning! ***Before performing any machine maintenance or adjustments, make sure the key switch is off, the key is removed from the machine and the parking brake is engaged.***

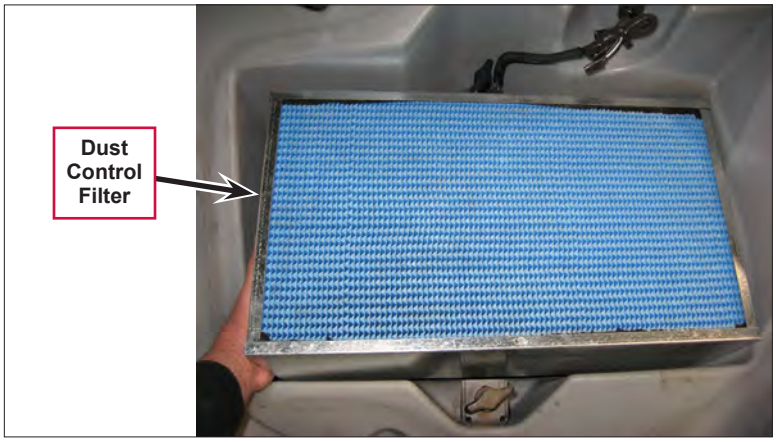
To Clean the Dust Control Filter

To Remove the Dust Control Filter

1. Lift the hopper cover.
2. Disconnect the **Shaker Motor Electrical Connector**.
3. Loosen the two **Thumb Nuts**, then slide the **Filter Shaker Assembly** toward the left and remove it from the machine.



4. Lift the **Dust Control Filter** out of the machine.
5. Inspect the top of the **Dust Control Filter** for damage. A large amount of dust on top of the **Filter** is usually caused by a hole in the **Filter** or a damaged filter gasket.



To Clean the Dust Control Filter

Caution:
- ***Wear safety glasses when cleaning the filter.***
- ***Clean the filter in a well-ventilated area.***
- ***Be careful not to puncture the filter element.***

1. Check the filter surfaces, and urethane gasket on the bottom of the filter for signs damage. If the filter surfaces or gasket are damaged, replace the filter.
2. Clean the dust control filter using either of the two methods below:

   Method 1:

   a. Vacuum any loose dust from the filter.

   b. Gently tap the filter against a flat surface (with the dirty side down) to remove loose dust and dirt.

   Method 2:

   a. Vacuum any loose dust from the filter.

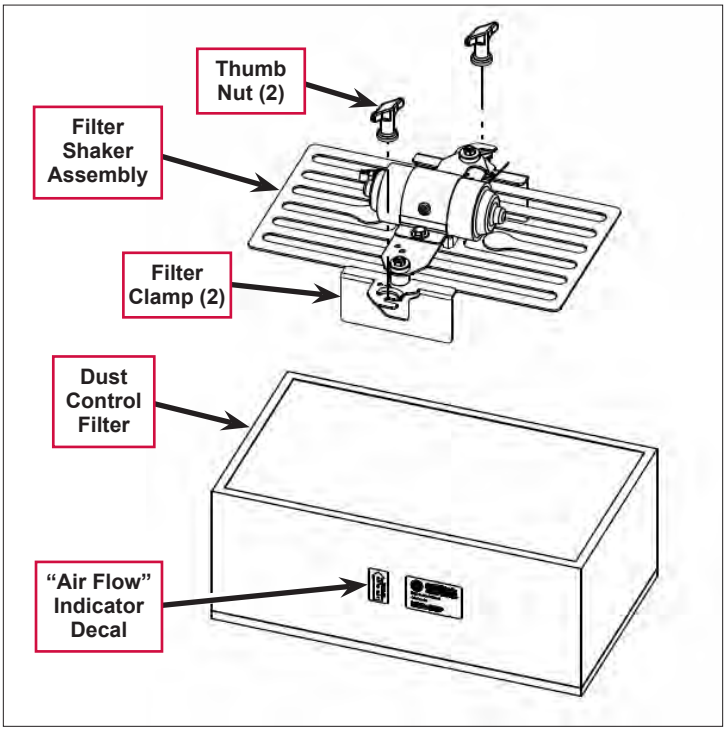
   b. Blow compressed air (maximum pressure 100 psi) into the clean side of the filter (in the opposite direction of the airflow).

To Reinstall the Dust Control Filter

1. Install the **Dust Control Filter** into the recess in the upper hopper.

Note: *Make sure the arrow on the* ***"Air Flow" Indicator Decal*** *on the side of the filter is pointing upward.*

2. Install the **Filter Shaker Assembly** onto the **Dust Control Filter**. Make sure the shaker motor electrical connector is positioned toward the rear of the machine.
3. Slide the **Filter Shaker Assembly** toward the right so the **Filter Clamps** engage the **Thumb Nut** studs on the upper hopper.
4. Tighten the two **Thumb Nuts**.
5. Reconnect the **Shaker Motor Electrical Connector**.
6. Close the hopper cover.



To Clean the DustGuard™ Strainer Screen

1. Drain the water from the upper hopper. Note that you can do this one of several ways. The most convenient way is to remove the **Strainer Cover** and **Screen** and drain the upper hopper through the DustGuard™ strainer.

Note: *Place a suitable container underneath the upper hopper to catch the water from the hopper reservoir.*

2. Raise the hopper and engage the prop rod.

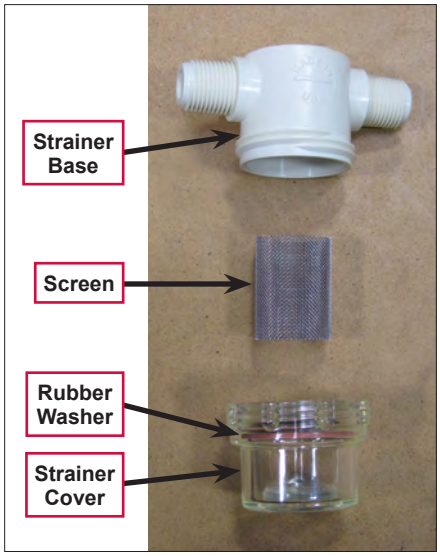
Note: *Place a suitable container underneath the filter to catch any water that may leak from the hoses.*

3. Unscrew the **Strainer Cover** and remove the **Strainer Cover** and **Screen** from the **Strainer Base**.

4. Clean any accumulated dirt or debris from the **Screen**.

5. Reinstall the **Screen** into the **Strainer Base**.

6. Make sure the **Rubber Washer** is installed correctly in the **Strainer Cover**, then reinstall and hand-tighten the **Strainer Cover**.



To Clean the DustGuard™ Spray Nozzles

1. Raise the hopper slightly if desired for easier access to the DustGuard™ nozzles.

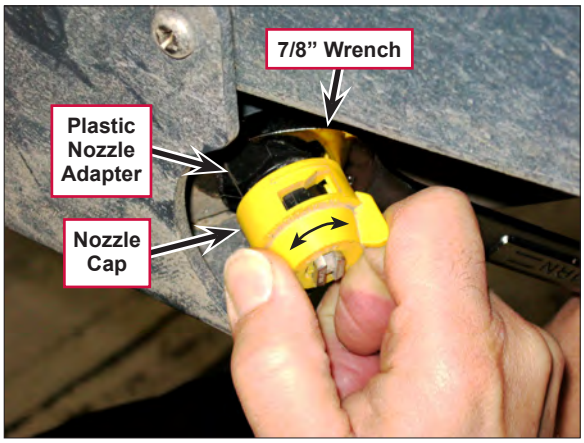
Note: *Place a suitable container underneath the nozzles to catch any water that may leak from the hoses.*

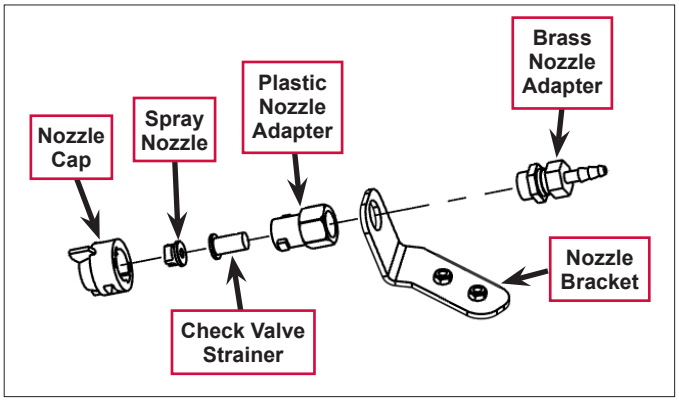
2. Hold the **Plastic Nozzle Adapter** with a **7/8" Wrench** to keep it from rotating in the **Nozzle Bracket** when you remove the **Nozzle Cap**. This will maintain the correct spray pattern orientation of the **Spray Nozzle**.

3. Rotate the **Nozzle Cap** one-quarter turn counterclockwise (as viewed from the front of the machine) to remove the **Nozzle Cap**, **Spray Nozzle** and **Check Valve Strainer** from the **Plastic Nozzle Adapter**.

4. Rinse the **Nozzle Cap**, **Spray Nozzle** and **Check Valve Strainer** in clean water to remove any accumulated dirt or sediment. If necessary, rinse or soak the components in vinegar or other commercial cleaner to remove any mineral deposits.

5. Reassemble the DustGuard™ nozzles by following the above steps in reverse order.



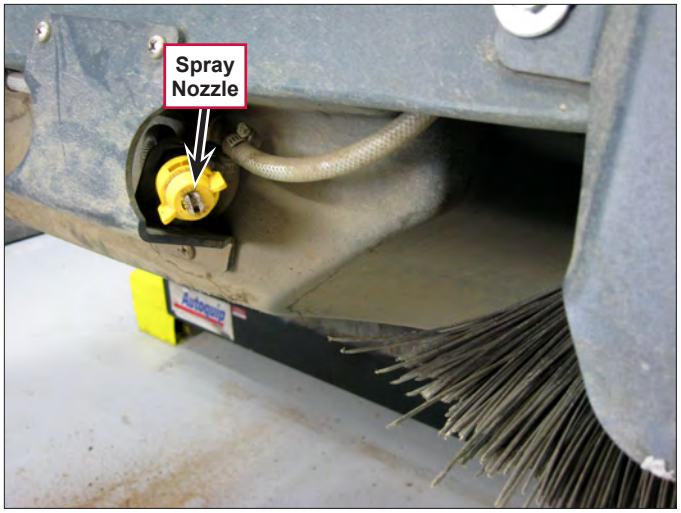


To Adjust the DustGuard™ Spray Nozzles

The **Spray Nozzles** should be approximately 10 to 20 degrees from vertical as shown in order to spray the water evenly top to bottom in front of the side brooms. (Note that the hopper has been raised slightly in the adjacent photo.) The spray pattern should wet the floor across the whole width of the side broom. If the spray pattern is not correct:

1. Carefully rotate the **Plastic Nozzle Adapter** with a **7/8" Wrench** to orient the **Spray Nozzle**.

2. After you rotate the **Plastic Nozzle Adapter**, make sure the **Brass Nozzle Adapter** is holding **Plastic Nozzle Adapter** securely in the **Nozzle Bracket**. Tighten the **Brass Nozzle Adapter** to the **Plastic Nozzle Adapter** as necessary.



Troubleshooting

Note: *You can use the Service Mode to toggle the various system components on and off to check for function. Refer to the* ***Control System/Service Mode*** *section for information on how to enter and use the Service Mode.*

Problem	Cause	Correction
The DustGuard™ system does not operate.	The DustGuard™ system is not installed in the configuration menu.	Make sure the DustGuard™ system is installed in the configuration menu.
Inadequate water flow to the DustGuard™ nozzles	Inadequate water level in upper hopper	Check the water level.
	The water strainer screen is plugged.	Clean the strainer screen.
	The water hoses/nozzles are plugged.	Check and clean the water hoses/nozzles as necessary.
	The water solenoid valve is plugged or not functioning correctly.	Check for voltage at the solenoid valve. • If there is voltage at the solenoid, check the solenoid coil resistance. It should measure 125 ohms ± 10%. If the coil resistance is not within spec replace the solenoid valve. • If there is no voltage at the solenoid: 1. Check the wiring and circuit breakers upstream of the solenoid. 2. Check the **J3-13** output from A1 Main Machine Controller.
	The DustGuard™ pump (**M22**) is not operating correctly.	Check for voltage at the pump. • If there is voltage at the pump, replace the pump. • If there is no voltage at the pump: 1. Check the wiring and circuit breakers upstream of the pump. 2. Check the **J3-13** output from A1 Main Machine Controller.

Problem	Cause	Correction
The dust control motor will not run.	The dust control filter switch is closed, indicating that the filter is plugged.	1. Clean the filter. 2. Check the dust control filter switch. The switch should be open with no vacuum in the hopper (dust control motor off). Replace the dust control filter switch if necessary.
	There is no voltage to the dust control motor.	1. Check the wiring and circuit breakers upstream of the dust control motor. 2. Check the coil resistance in the **K6** contactor coil. If the coil resistance is not 118 ohms ± 10%, replace the contactor. 3. Check the continuity through contactor **K6** with the coil energized. If the contacts are open, replace the contactor. 4. Check the **J2-6** output from A1 Main Machine Controller.
	The dust control motor is not operating correctly.	If there is voltage to the dust control motor, replace the motor.
The shaker motor will not run.	There is no voltage to the shaker motor.	1. Check the wiring and circuit breakers upstream of the shaker motor. 2. Check the **J2-18** output from A1 Main Machine Controller.
	The shaker motor is not operating correctly.	If there is voltage to the shaker motor, replace the motor.

Removal and Installation

Warning! ***Before removing or reinstalling any machine components, make sure the key switch is off, the key is removed from the machine and the parking brake is engaged.***

To Remove and Reinstall the DustGuard™ Solenoid Valve Assembly

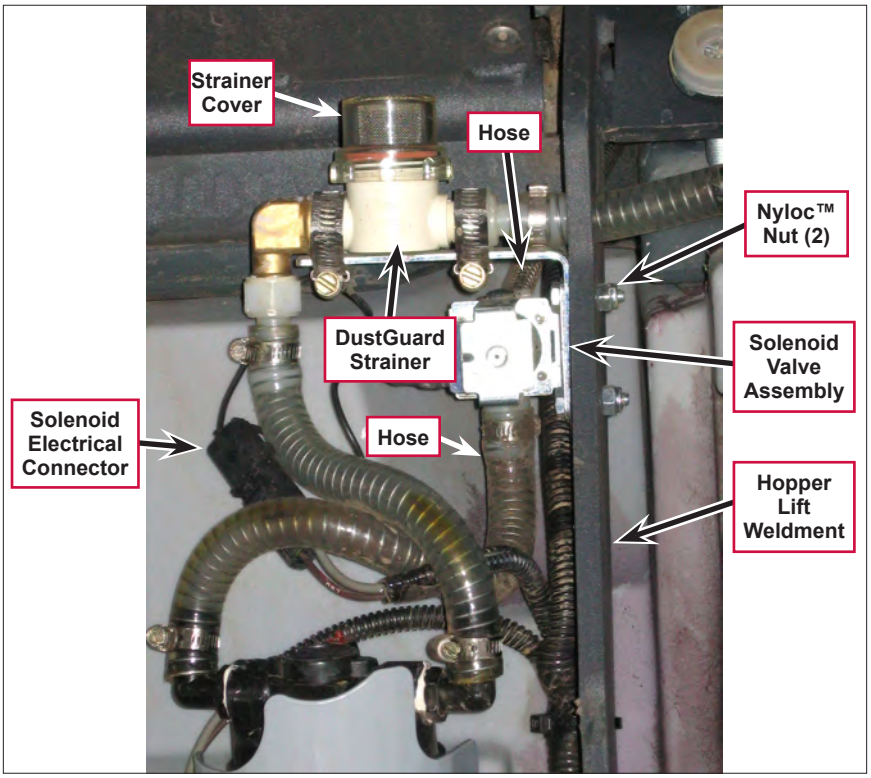
1. Drain the water from the upper hopper. Note that you can do this one of several ways. The most convenient way is to remove the **Strainer Cover** and screen and drain the upper hopper through the **DustGuard Strainer**.

Note: *Place a suitable container underneath the upper hopper to catch the water from the hopper reservoir.*

2. Turn the key switch on, raise the hopper and engage the prop rod, then turn off the key switch.

Note: *Place a suitable container underneath the* ***Solenoid Valve Assembly*** *to catch any water that may leak from the* ***Solenoid Valve Assembly*** *and hoses.*

3. Disconnect the **Solenoid Electrical Connector**.
4. Remove the two **Nyloc™ Nuts** holding the **Solenoid Valve Assembly** to the **Hopper Lift Weldment**.
5. Disconnect the two **Hoses** and remove the **Solenoid Valve Assembly** from the machine.
6. Reinstall the **Solenoid Valve Assembly** by following the above steps in reverse order.



To Remove and Reinstall the DustGuard™ Pump

1. Drain the water from the upper hopper. Note that you can do this one of several ways. The most convenient way is to remove the strainer cover and screen and drain the upper hopper through the DustGuard™ strainer.

Note: *Place a suitable container underneath the upper hopper to catch the water from the hopper reservoir.*

2. Turn the key switch on, raise the hopper and engage the prop rod, then turn off the key switch.

Note: *Place a suitable container underneath the* ***DustGuard Pump*** *to catch any water that may leak from the* ***DustGuard Pump*** *and hoses.*

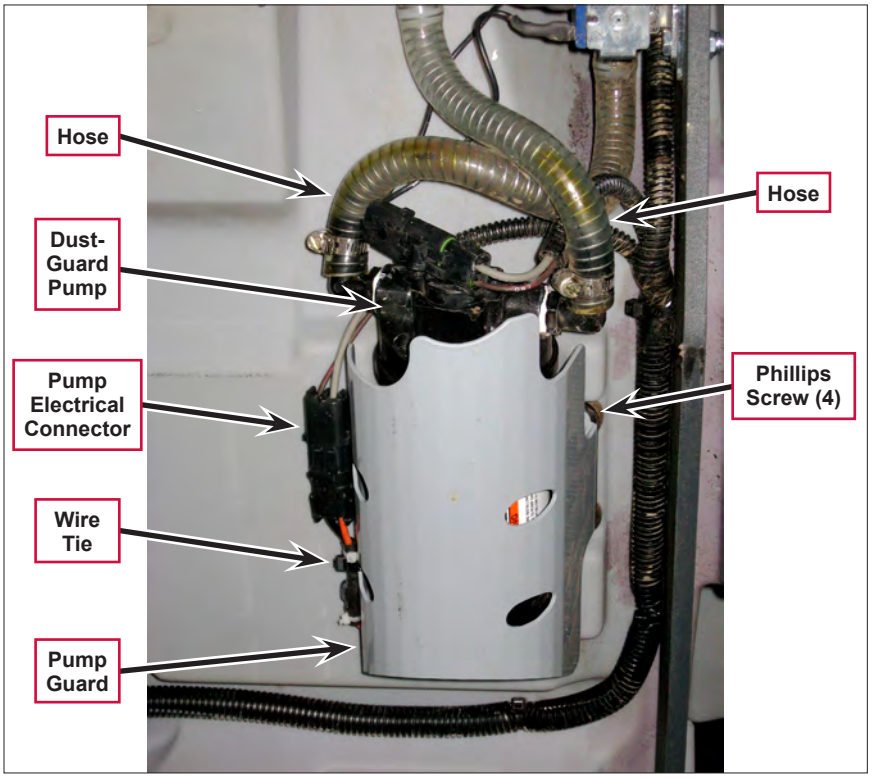
3. Disconnect the **Pump Electrical Connector**.

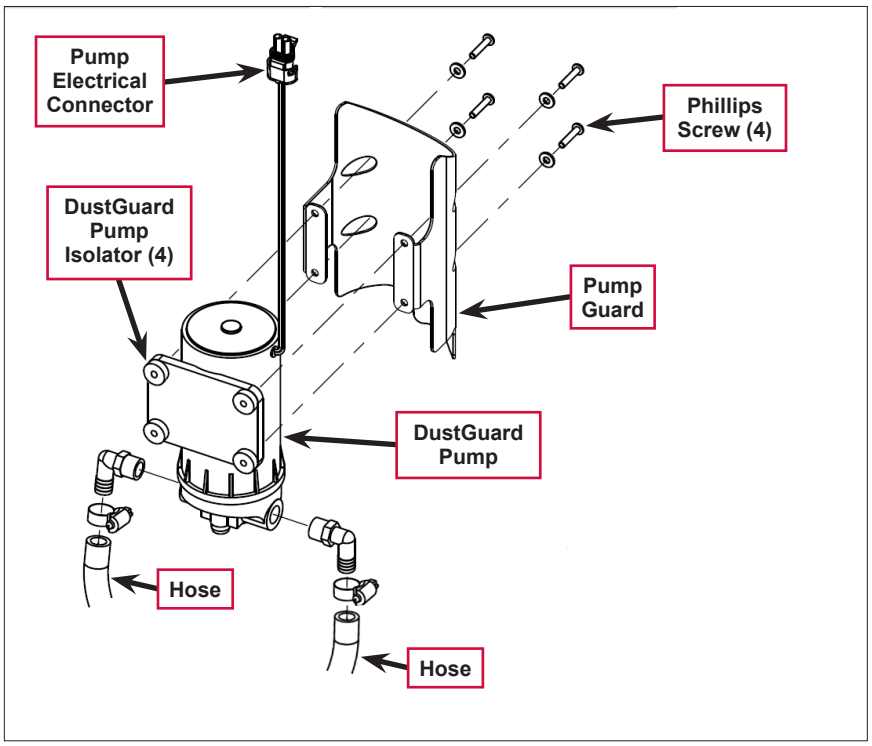
4. Disconnect the two **Hoses** from the **DustGuard Pump**.

5. Remove the four **Phillips Screws** and washers holding the **Pump Guard** and **DustGuard Pump** to the **Upper Hopper** and remove the **Pump Guard** and **DustGuard Pump** from the machine.

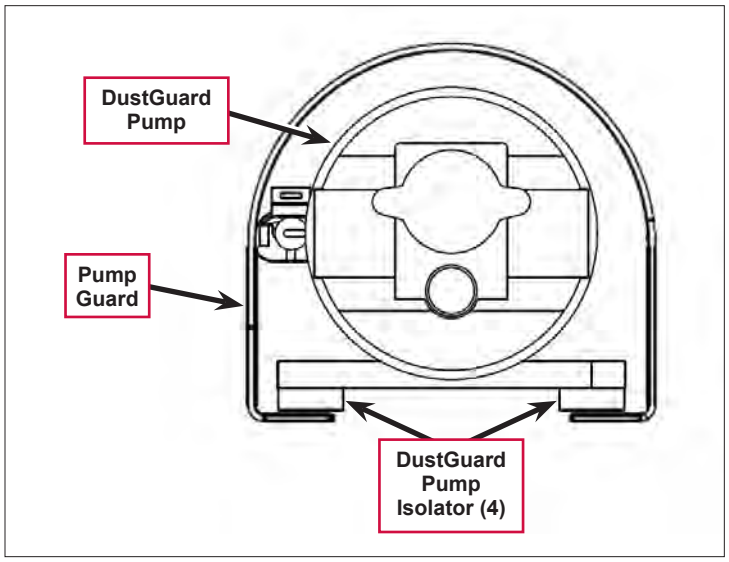
   Note that you'll need to cut the **Wire Tie** holding the **Pump Electrical Connector** wires to the **Pump Guard** in order to separate the **Pump Guard** and **DustGuard Pump**.

6. Reinstall the **DustGuard Pump** by following the above steps in reverse order.



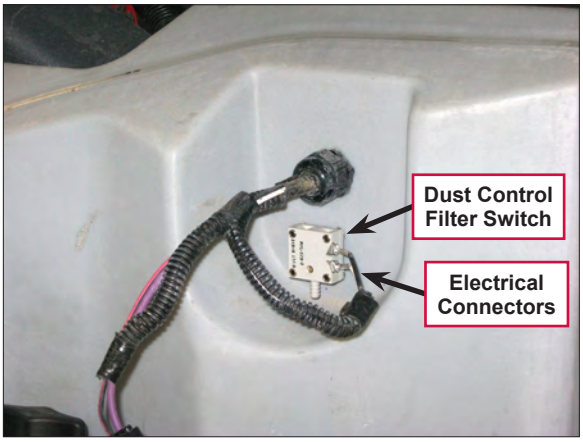


*Note: The **Pump Guard** base should be positioned under the four **DustGuard Pump Isolators**.*



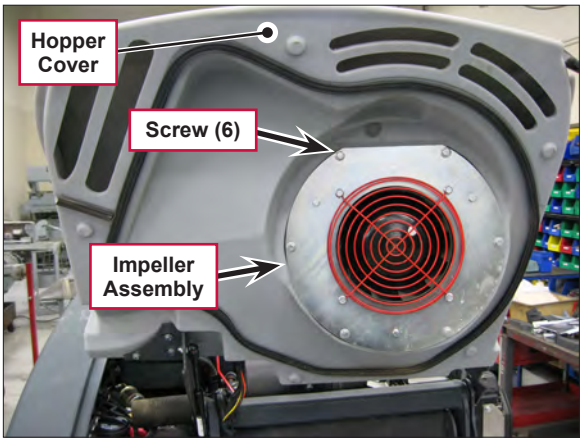
To Remove and Reinstall the Dust Control Filter Switch

1. Lift the hopper cover.
2. Disconnect the two **Electrical Connectors** from the **Dust Control Filter Switch**.
3. Unscrew the **Dust Control Filter Switch** from the upper hopper.



To Remove and Reinstall the Impeller Assembly

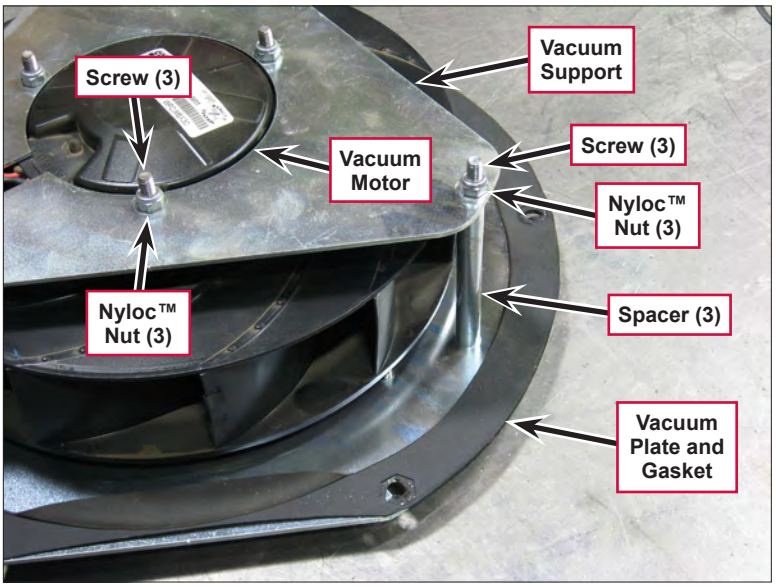
1. Lift the **Hopper Cover**.
2. Remove the six **Screws** and washers holding the **Impeller Assembly** to the **Hopper Cover**.
3. Carefully pull the **Impeller Assembly** partway off of the **Hopper Cover**.
4. Disconnect the **Vacuum Motor** electrical connector, then remove the **Impeller Assembly** from the machine.
5. Reinstall the **Impeller Assembly** by following the above steps in reverse order.

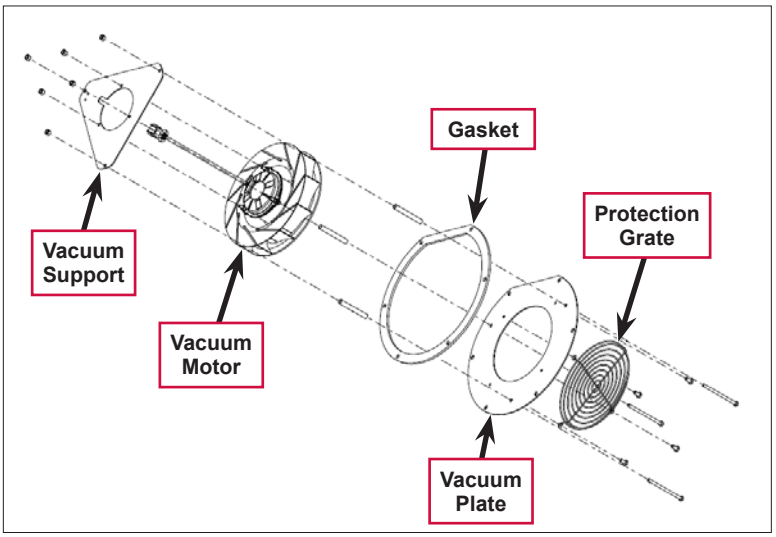


To Disassemble and Reassemble the Impeller Assembly

1. Remove the three **Nyloc™ Nuts**, **Screws** and **Spacers** holding the **Vacuum Plate and Gasket** to the **Vacuum Support** and attached **Vacuum Motor**.

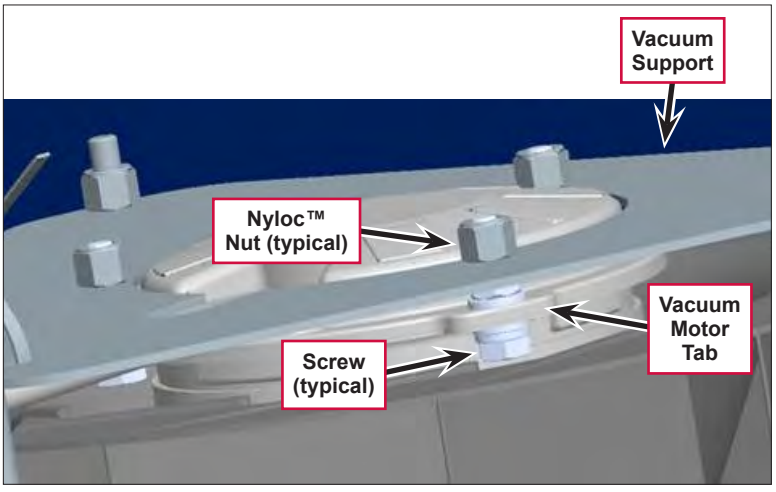
2. Remove the three **Nyloc™ Nuts** holding the **Vacuum Motor** to the **Vacuum Support** and remove the **Vacuum Motor**.





Note: *To prevent the three* ***Screws*** *from spinning when removing the* ***Nyloc™ Nuts*** *to remove the* ***Vacuum Motor****, place a wrench on the* ***Screw*** *heads under the* ***Vacuum Motor Tabs****.*

3. Reassemble the impeller assembly following the above steps in reverse order.



Specifications

Component	Specifications
DustGuard Pump	Type - Diaphragm w/bypass
	Nominal Voltage - 36 VDC
	Flow Rate - 1.1 GPM
	Current - 1.0 Amp max.
	Pressure - 30 psi max.
DustGuard Solenoid Valve	Nominal Voltage - 36 VDC, 11 Watts
	Coil Resistance - 125 Ohms ± 10%
Dust Control Filter	Media Type - synthetic with UltraWeb (cellulose optional)
	Media Quantity - 120 ft^2 (approximate)
	Media Configuration - PowerCore
Dust Control Vacuum Motor	Current - 7 Amps average, 8 Amps max.
Dust Control Motor Contactor (K6)	118 Ohms ± 10%
Dust Control Filter Switch	Actuation setting ± 20%: factory set at 2" H_2O/ 0.147" Hg/0.072 psi
Filter Shaker Motor	Voltage - 36 VDC
	Current - 0.8 Amps average
	Power - 90 Watts
	Ingress Protection - IP44
	Insulation Class - B
	Duty - intermittent (S2 10 min.)

Electrical System

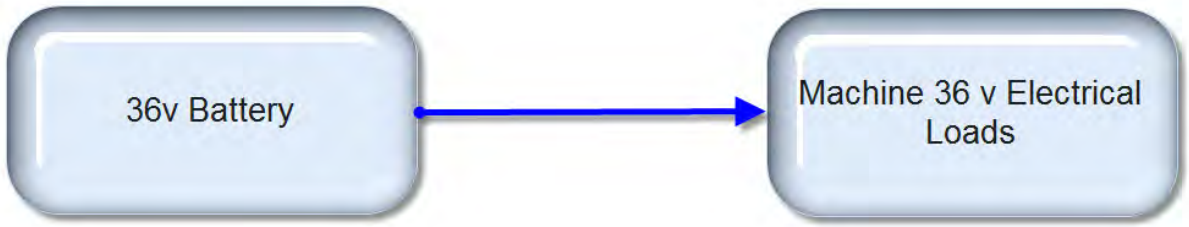
The electrical system chapter contains wiring diagrams, electrical panel information and covers other components that are not covered in other chapters. For instance, the Solution Pump is covered in the Solution System Chapter.

Functional Description

Overview

The CS7000 uses electricity to operate almost everything. The “Battery” model has a large capacity 36 volt storage battery for its only power source.

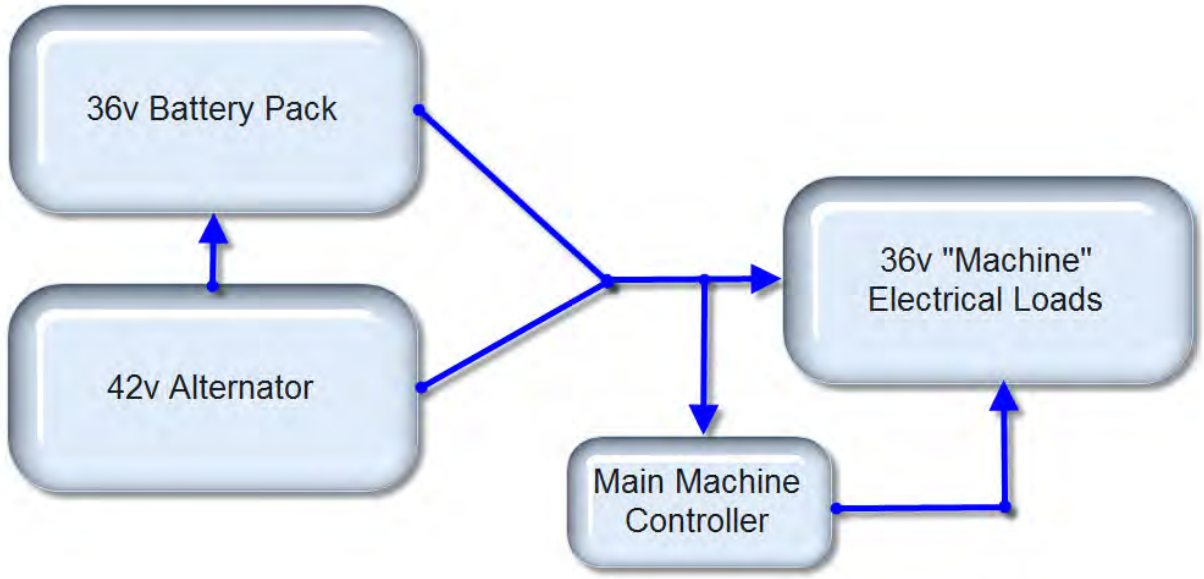
Power from the 36v battery supplies all machine electrical loads.



Battery Model Power Distribution

"Hybrid" models use a large, engine-driven 42 volt generator for their main power source with a smaller 36 volt battery pack connected in "parallel" with the generator, as a "back up".

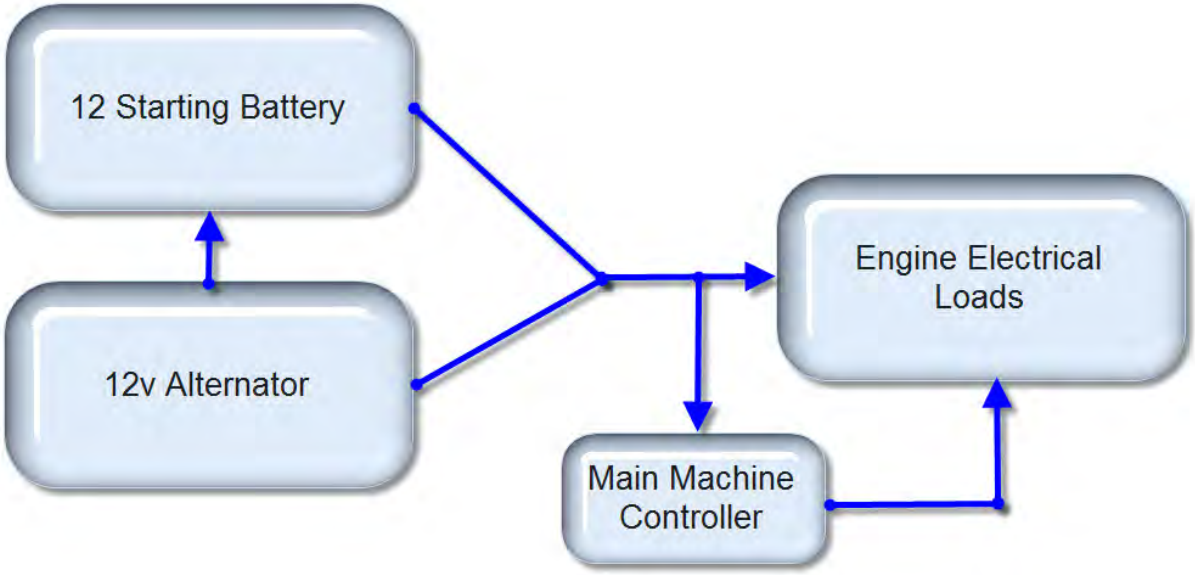
When the engine is running the 42 volt generator provides the electrical power to operate the 36v machine electrical loads as well as recharge the 36v battery pack. If the machine demands more current than the 42 volt generator can provide, the 36 volt battery pack supplies the extra boost that is needed. If the engine is not running the machine can work for a limited time on just the 36 volt battery pack The main machine uses a 36v supply to operate some 36v electrical loads.



Hybrid Power Supply

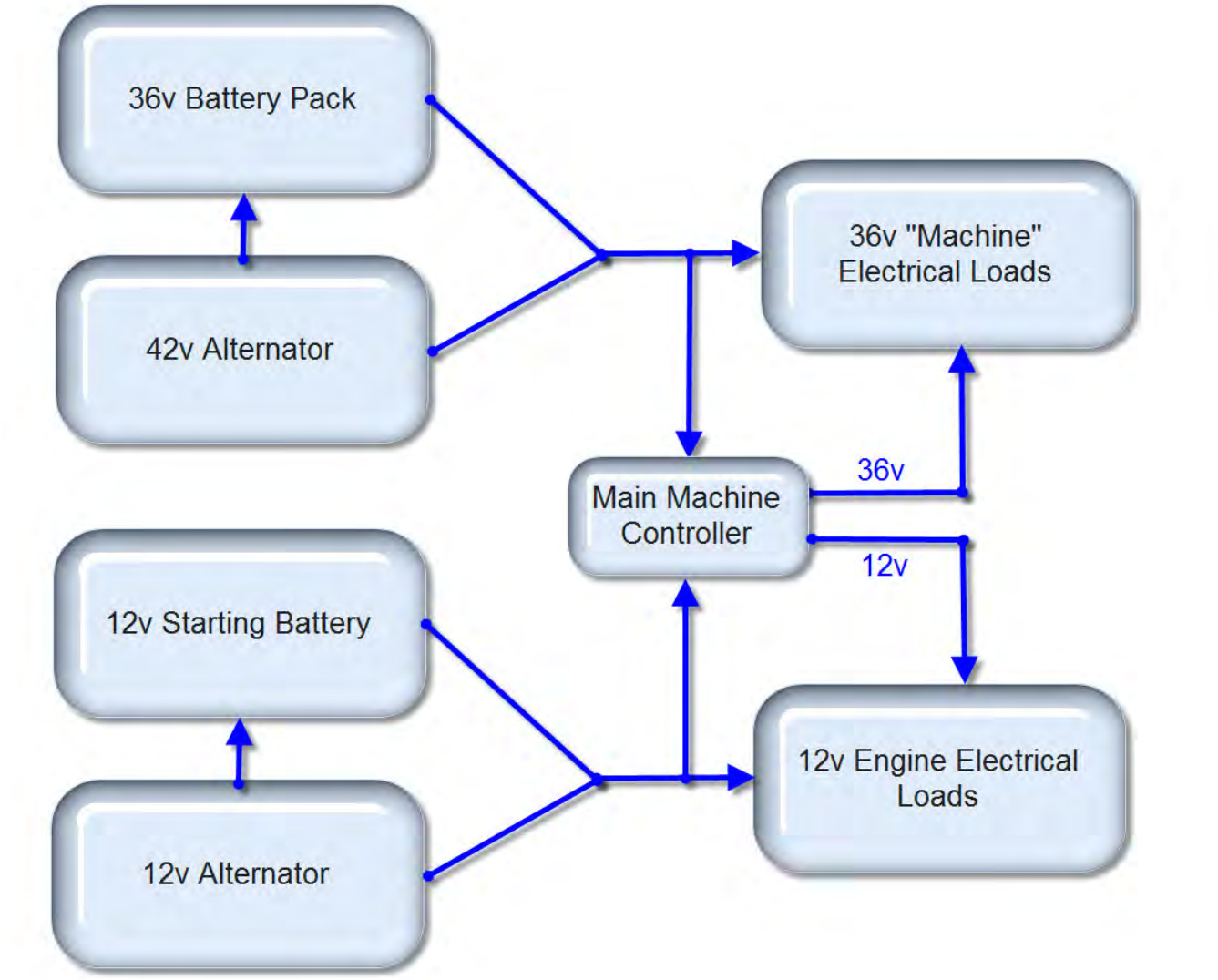
Hybrid models also have a separate 12 volt starting battery.

The main purpose of the staring battery is to start the engine. The engine drives a separate 12 volt generator (Alternator) to recharge the starting battery and supply power for 12v engine electrical loads. The main machine controller is supplied a 12v power source which it uses to control some 12v engine electrical devices.



12v Power Distribution - Engine models only

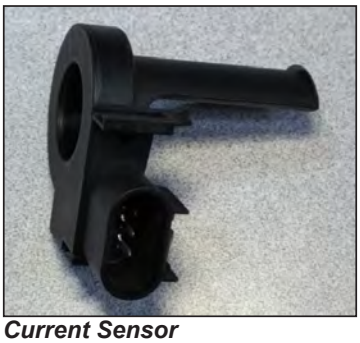
If you combine the power distribution for both the engine electrical loads and the 36v machine electrical loads it looks like this.



Combined Power Distribution - Engine Models

All models have a large connector to disconnect power from the machine. A circuit breaker panel located on the left side of the operator foot well area provides circuit protection for multiple circuits.

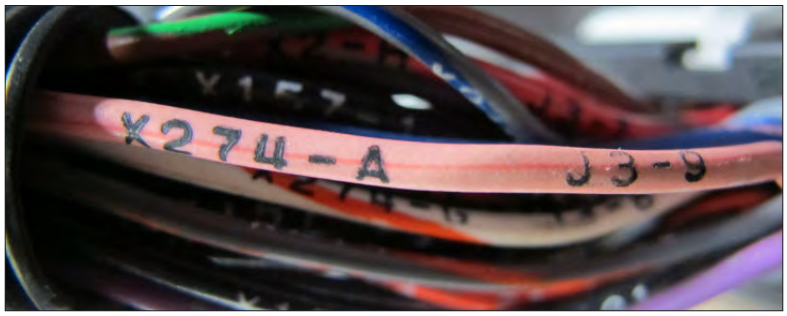
The electrical system makes use of hall effect current sensors to provide amp draw information to the main machine controller for some circuits.



Current Sensor

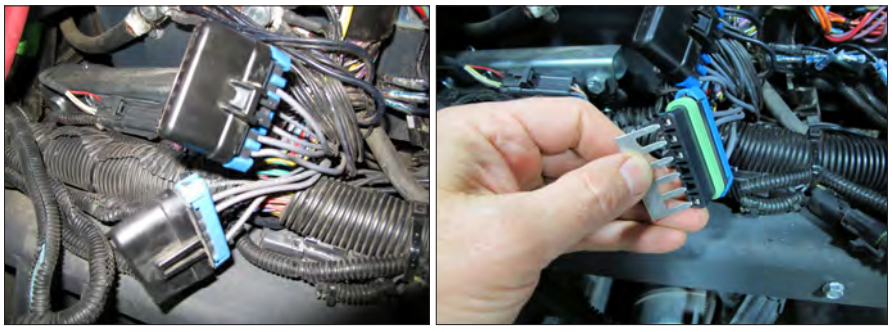
Wiring Harnesses

Wires are color coded and have connector information printed near each end of the wire. In the photo below, the left end of the wire goes to connector X274 pin A and the right side of the wire goes to connector J3 pin 9.



The main harness is the same for all models. Connectors which are not used for certain models or features have plugs covering them or may be "jumped" together as is the case for the battery interlock switch on engine models.

There are splices in the harness that are shrink wrapped. There are also two "splice saver" connectors which look like capped off connectors, but actually connect many wires together through a "comb" that is inserted into the connector.



The CAN Bus wire pairs are twisted to prevent electrical interference from corrupting the messages. If any repairs are performed on the CAN Bus wires, the wire pairs must be twisted approximately once per inch.

Circuit Protection

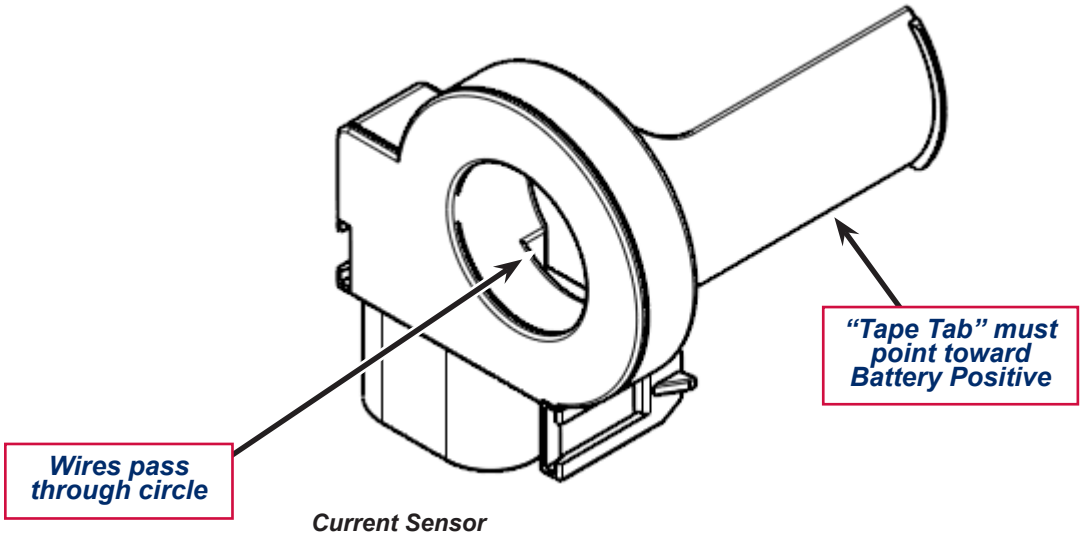
Circuit protection is accomplished with both fuses and circuit breakers. There are 2 large fuses. F1 is a 400 amp fuse that provides “complete machine” protection. F2 is a 150 amp fuse that protects the motor circuits for the main broom, scrub motors and vacuum motors.

Switched Power

A key switch (Ignition Switch) is used to provide switched power to the main machine controller but it carries only a small amount of current. The main machine controller in turn energizes an Auxiliary Contactor to provide 36 volt high current capacity supply to many circuits. The main machine controller also energizes an Auxiliary Relay which provides a 12 volt power supply to itself. The main machine controller then uses this 12 volts to switch out to various circuits like the Ignition output to the engine system.

Current Sensors

The CS7000 utilizes 3 hall effect current sensors to report amp draw information for the vacuum motors, scrub motors and main broom motor to the main machine controller. They work much like an inductive amp clamp for a digital multi-meter. The motor circuit ground wires run through the “circle loop”. The sensor “reads” the amperage and converts it to a voltage value for the main machine controller to “read”. With no current flow, the sensors report 2.5 volts. As current increases the voltage increases. (Provided the sensors are installed correctly. If they are installed “backwards” the voltage will drop with increased current).



Current Sensor

42 Volt Alternator (Generator)

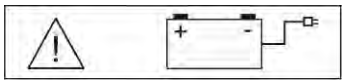
The 42 volt generator provides the electrical power needed to operate the machine and to recharge the 36 volt battery pack. It is belt driven by a pulley located at the rear of the engine (Right side of machine).

Lighting

All headlights, curb light, taillights and turn lights are controlled by the main machine controller. Head lights are standard. The curb light and turn lights are optional See the ***Options and Accessories*** chapter for more information on curb lights and turn lights.

Low Voltage Cutout

The scrub system and solution system are cut off by the main machine controller if the system voltage falls too low (Approx 31.5v for “wet” batteries or 32.94v for gel batteries). This is done to prevent damaging the batteries from over discharging. The operator will see the low voltage warning icon displayed when the low voltage cut out mode is active

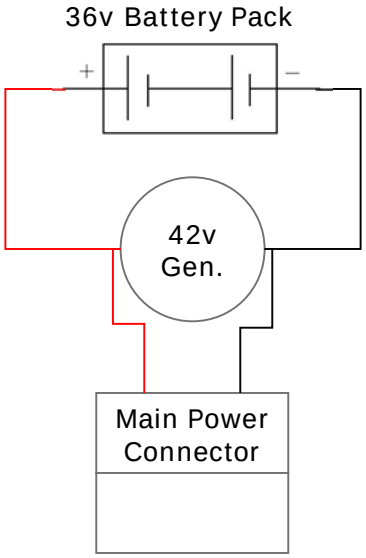


There are actually two levels of low voltage cut off. The first level disables the scrub and sweeping functions. The second level will also disable the recovery function. In either case, the hopper functions are not disabled. Once the machine has gone into the low voltage cut out mode, the batteries must be **fully** recharged before normal operation is restored (Approx 38.7v) .

Circuit Descriptions

42 Volt Generator

The 36 volt battery pack positive cable runs directly to the 42 volt generator positive terminal. The battery pack negative cable runs directly to the 42 volt generator negative terminal. The generator positive and negative terminals also have cables that go to the main power connector. When the main power connector is connected, this supplies power to the entire machine.



Headlights

Two types of headlights are used on the CS7000. Early machines, use incandescent 12v halogen bulbs. Later machines use LED headlights. The machine must be properly configured to operate each type correctly using the ***Configuration Menu.***

Incandescent Headlight

LED Headlight

Incandescent Headlights

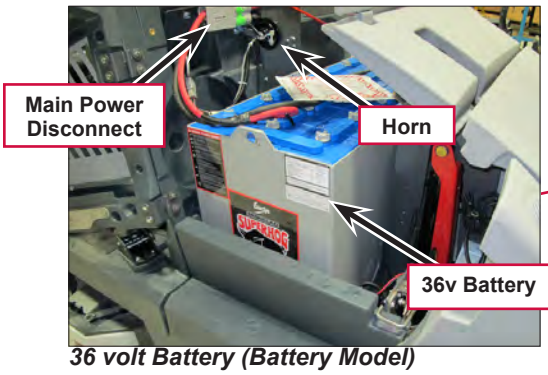
Battery positive power is supplied to the head lamps through, F1, CB6 (VACC6), and the K15a Auxiliary relay contacts. The other side of the headlights are wired in parallel to the main machine controller J2-23. To turn the headlights on, the controller switches J2-23 to ground. (It is not a complete ground. It is Pulse Width Modulated to provide approximately 3.3 volts rather than full machine system voltage.)

LED Headlights

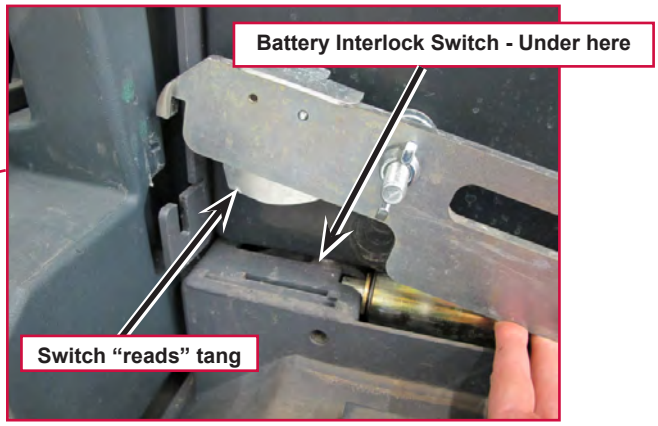
Battery positive power is supplied to the head lamps through, F1, CB6 (VACC6), and the K15a Auxiliary relay contacts. The other side of the headlights are wired in parallel to the main machine controller J2-23. To turn the headlights on, the controller switches J2-23 to ground which applies full system voltage to the headlights.

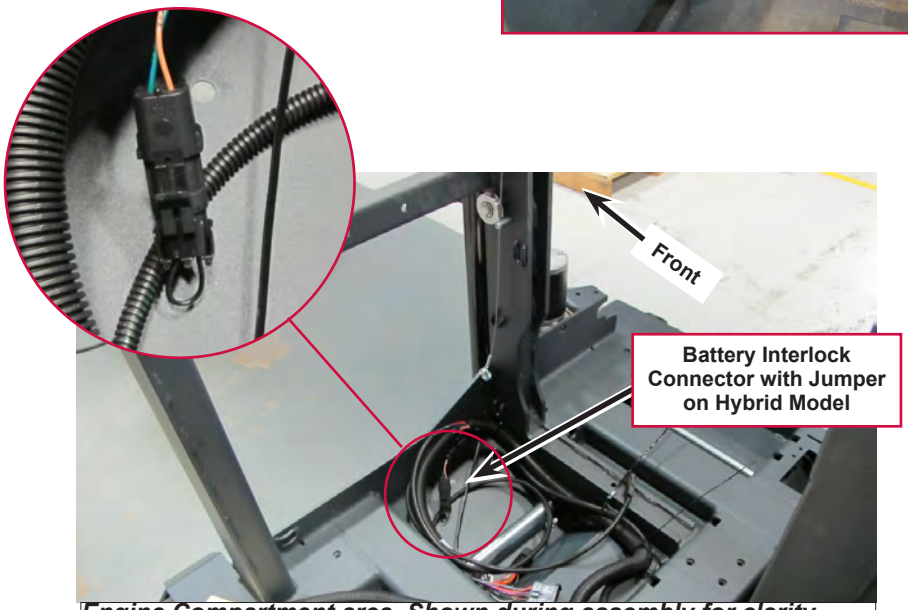
Component Locations

- 36 volt Battery (Battery Model)
- 36 volt Battery Pack (Hybrid Models) - Right of engine under fuel tank.
- 42 volt Generator - Front of engine behind rubber shield. (Raise hopper for access.)
- Circuit Breaker Panel
- Starting Battery
- Electrical Panel - Left side of solution tank under metal plate. (Remove recovery tank for access.)
- Main Fuse F1 400 Amps
- F2 150 Amp Fuse
- Auxiliary Relay - See Electrical Panel
- Auxiliary Contactor - See electrical panel
- Horn
- Battery Interlock Switch (Hybrid models use a jumper in place of this switch)
- Seat Switch

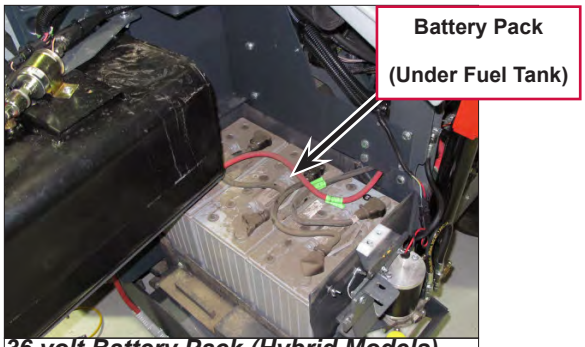


36 volt Battery (Battery Model)



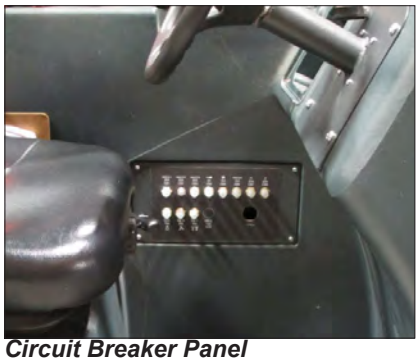


Engine Compartment area. Shown during assembly for clarity.

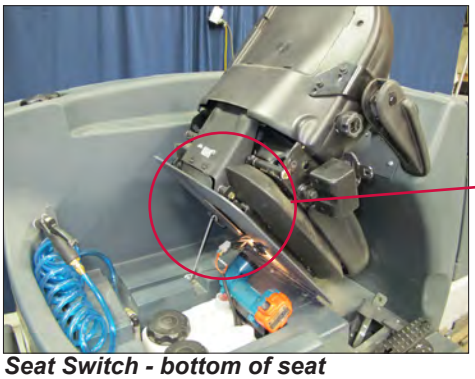


36 volt Battery Pack (Hybrid Models)

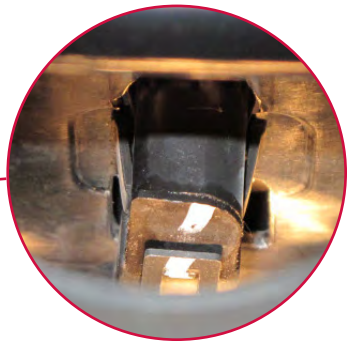
Starting Battery

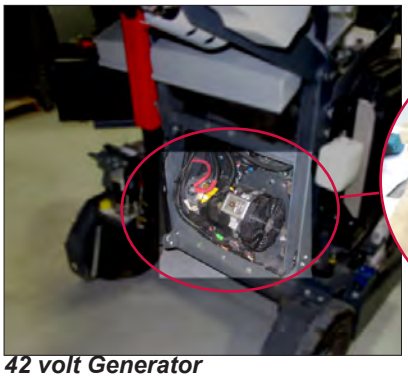


Circuit Breaker Panel



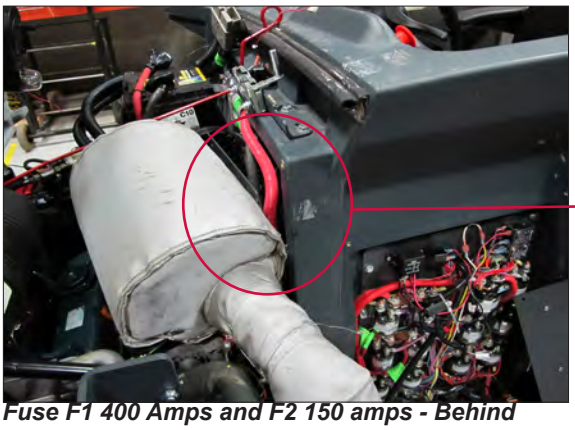
Seat Switch - bottom of seat





42 volt Generator

Electrical Panel

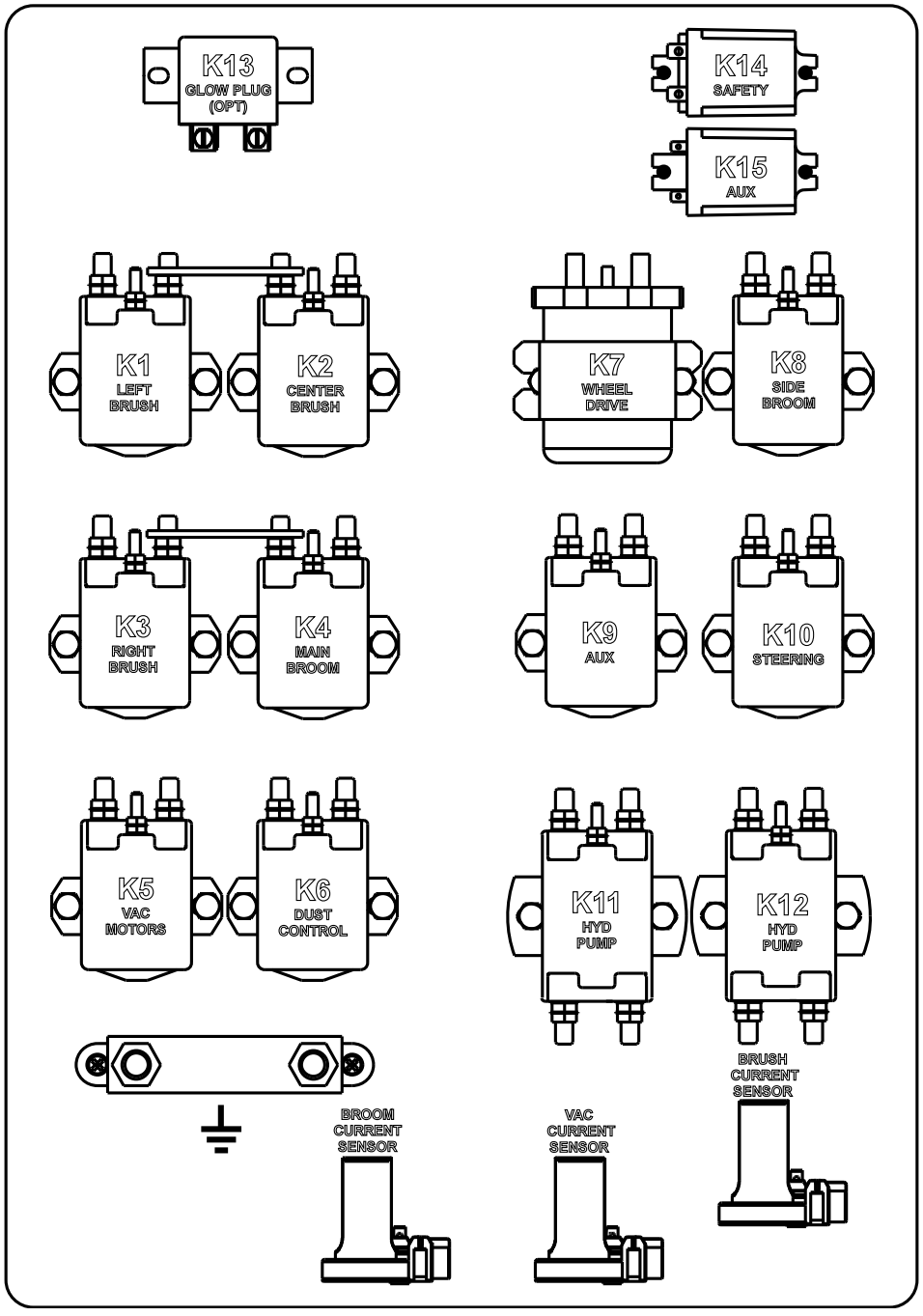


Fuse F1 400 Amps and F2 150 amps - Behind metal panel. Shown with panel pulled forward

Fuse F1 400 Amps - Side view. Shown with panel pulled forward

Electrical Panel Contactor/Relay location

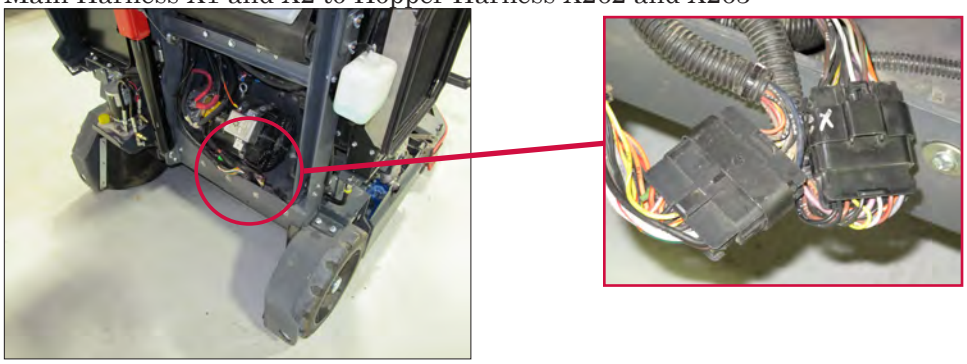
Electrical Panel



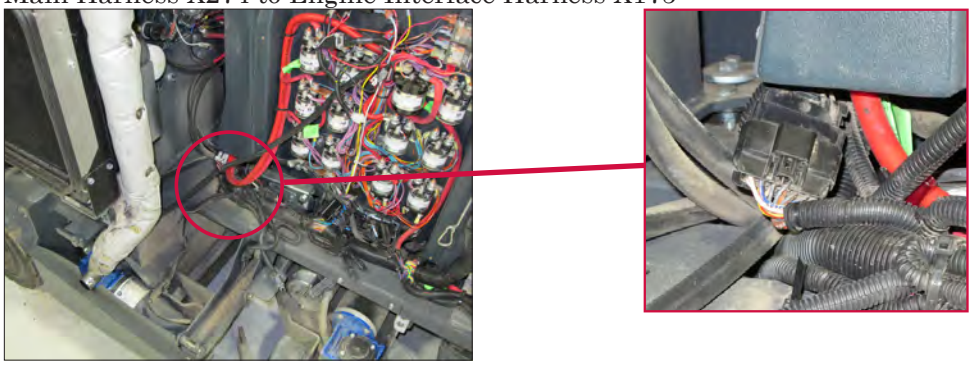
Harness to Harness Connector Locations

Most connectors are plugged into a component like the squeegee actuator; find the squeegee actuator and you can locate the squeegee actuator electrical connector. However, there are a few connectors that connect two harness. These are pictured here.

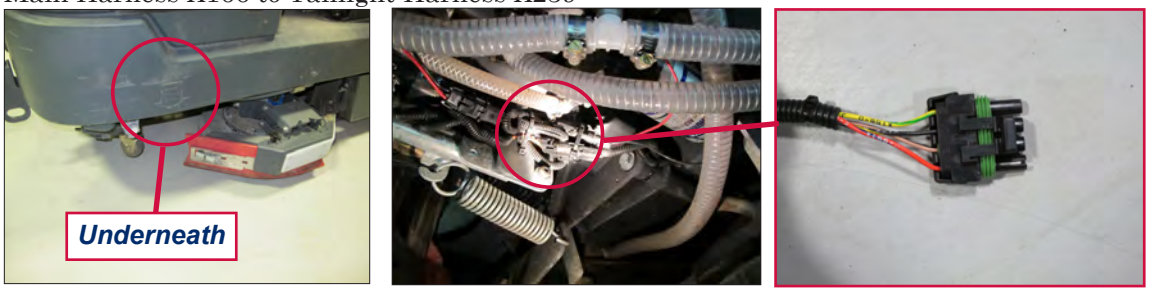
- Main Harness X1 and X2 to Hopper Harness X262 and X263



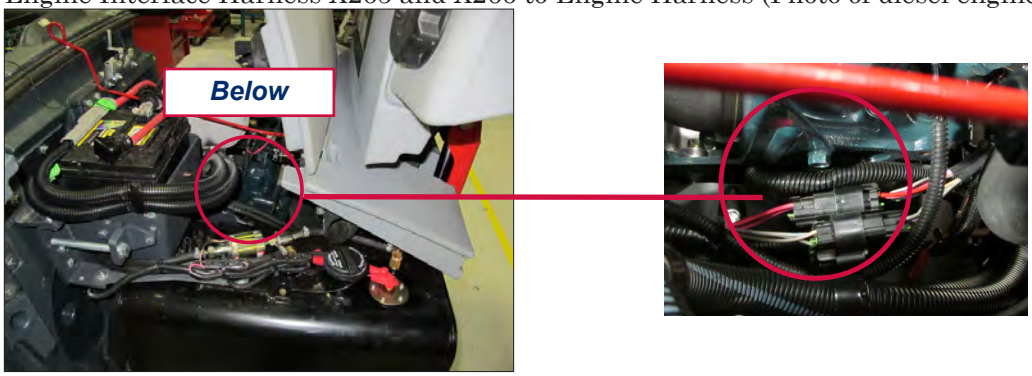
- Main Harness X274 to Engine Interface Harness X175



- Main Harness X166 to Taillight Harness X239



- Engine Interface Harness X265 and X266 to Engine Harness (Photo of diesel engine)



Connector Pin-Outs

The following pages contain details about every electrical connector that contains more than one “cavity”. The connector pin-out information is organized with a table on the left which identifies the location of wires in the connector and images on the right which show what the connector looks like. The table on the left has a header that describes the connector ID, the name of the component that it plugs into and the component’s ID number. (There are a few connectors that do not plug into a component but plug into another harness or are empty. These have the connector ID and the “name” of the connector only.) The images to the right of each table have a “3 dimensional” view of the connector to help you recognize it on the machine and a “2 dimensional” view of the “back side” or “wire side” of the connector. This is to help you match up the wires and pin numbers of the connector.

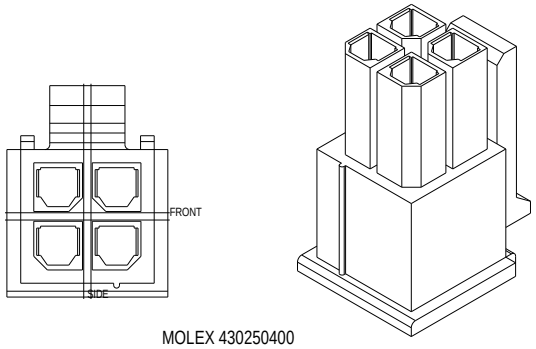
The connector pin-out information is organized by the connector ID in alphabetical order. If you are viewing this document on a computer, you can search for the component ID or component name to find the pin out chart. However, if you are viewing a paper copy, it will be easier for you to find the correct pin-out table if you know the connector ID. To learn the connector ID, find the component ID from the wiring diagram. Then use the “Component ID to Connector ID Look Up Table” below to find the connector ID.

Component ID to Connector ID Look Up Table

Component ID	Component Name	Connector ID
A1	Main Machine Controller	J2
A1	Main Machine Controller	J3
A1	Main Machine Controller	J7
A2	Drive controller	J4
A3	Control panel	J1
A5	Steering controller	J5
B1	Brush Motor Current Sensor	X183
B2	Broom Motor Current Sensor	X181
B3	Vacuum Motor Current Sensor	X182
E4	Steering wheel sensor	X98
H1	Back up alarm (Optional)	X178
J8	Can bus programmer connector	J8
J10	Drive Controller Programmer	J10
L1	Solution Solenoid Valve	X190
L2	Dust guard valve	X140
LT1	Trouble light	X258
LT2	Right headlight	X162
LT3	Left headlight	X161
LT5	Taillight, right	X154
LT6	Taillight, left	X153
LT8	Curb light (optional)	X165
LT9	Stop turn light, left	X180
LT10	Beacon (optional)	X257
LT11	Stop turn light, right	X184
M1	Main Broom motor	X25
M2	Motor, left brush	X19
M3	Motor, center brush	X18
M4	Motor, right brush	X17
M5	Dust control motor	X21
M6	Vacuum Motor	X23

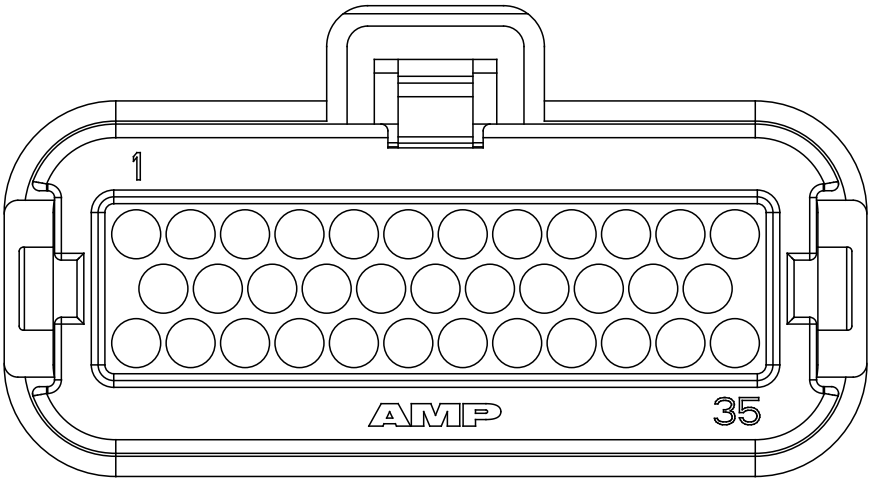
Component ID	Component Name	Connector ID
M7	Vacuum Motor	X24
M8	Right side broom motor	X28
M9	Left side broom motor	X26
M10	Hydraulic Pump, Hopper Lift	X126
M11	Scrub Deck Actuator Motor	X256
M12	Squeegee Lift actuator	X22
M13	Side broom actuator	X109
M14	Shaker motor	X20
M16	Steering Actuator	X97
M19	Pump, Solution Control (Optional)	X111
M20	Fuel pump	X275
M21	Main Broom actuator	X27
M22	Dust guard pump	X122
M23	Pump, Low Pressure (Optional)	X20
M23	Low Pressure Pump (Optional)	X120
M24	Wheel Drive Motor	X99
M24	Wheel Drive Motor	X100
M25	Pump, Extended Scrub (optional)	X118
M26	Dump door actuator motor	X124
R1	Drive Pedal Position Sensor	X145
S1	Scrub Deck Retract Limit Switch	X255
S3	Hopper Interlock Switch	X204
S4	Extended Scrub Level Switch (optional)	X268
S5	Brake switch	X202
S7	Dump door extend limit switch	X236
S8	Dump door retract limit switch	X238
S13	Battery interlock switch	X187
S16	Steering Travel Limit Switch, Right	X106
S17	Steering Travel Limit Switch, Left	X105

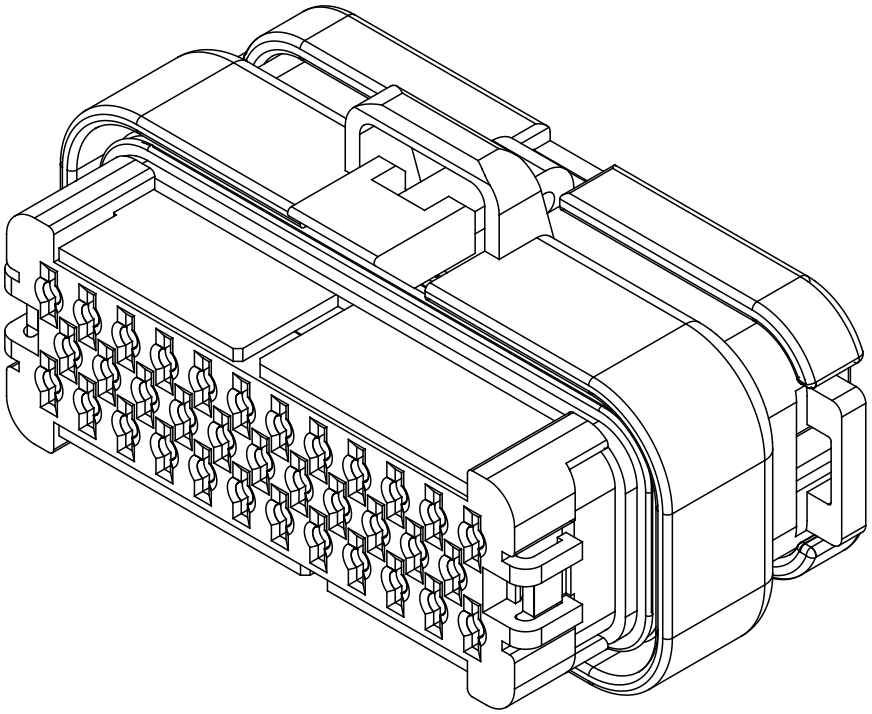
J1 - Control Panel (A3)	
Pin	Wire # Color
1	130 WHT/BRN
2	304 BLK
3	301 YEL
4	300 GRN



MOLEX 430250400

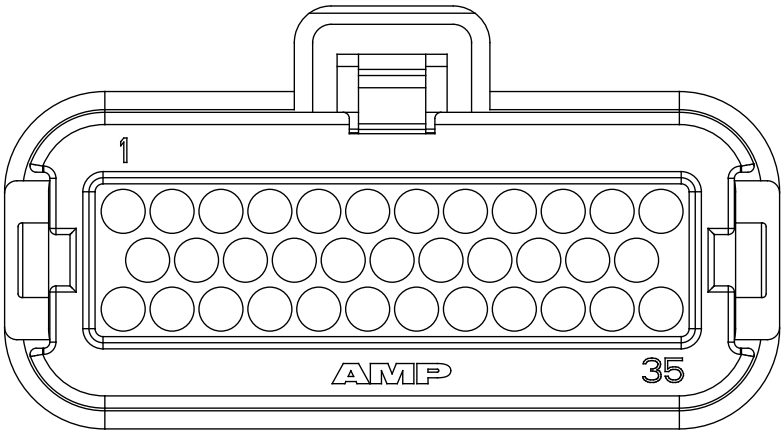
J2 - Main Machine Controller (A1)	
Pin	Wire # Color
1	091 ORN/YEL
2	094 ORN/BLU
3	098 YEL/RED
4	101 YEL/GRN
5	107 TAN/BLK
6	064 BLK/YEL
7	119 BRN/WHT
8	080 WHT/GRN
9	078 BLU/BRN
10	132 RED/GRN
11	135 YEL/GRA
12	162 BLK
13	057 VIO
14	051 BLK/ORN
15	163 BRN/BLK
16	063 GRN/GRA
17	045 BLU
18	150 BLK/RED
19	116 WHT/YEL
20	157 YEL/ORN
21	160 BLU/VIO
22	167 BLK/YEL
23	169 BRN
24	039 ORN/RED
25	047 YEL/BLU
26	015 WHT/VIO
27	061 GRA/RED
28	038 BLU/ORN
29	---
30	---
31	---
32	221 GRA/BLIU
33	---
34	054 BLK/WHT
35	053 BLK/WHT

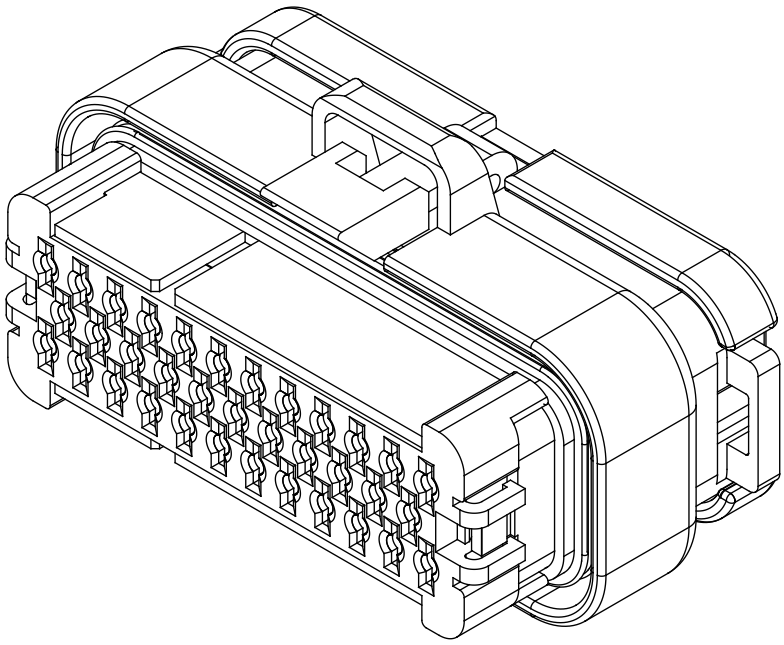




J2 **AMP 776164-2**
NEUTRAL

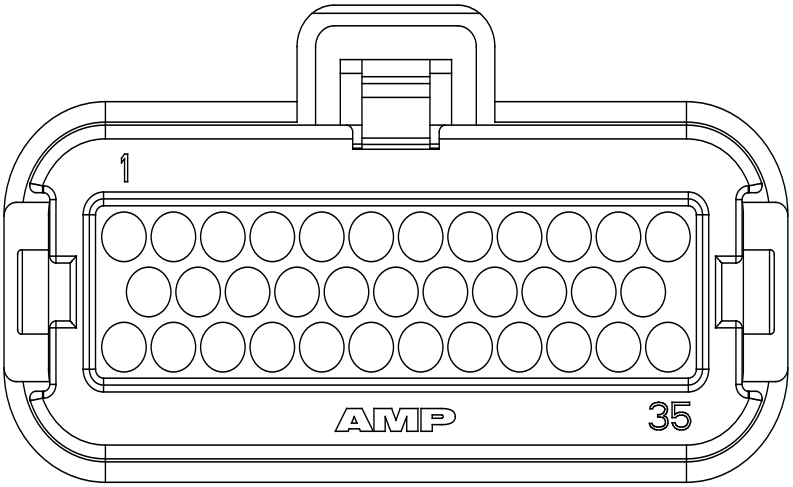
J3 - Main Machine Controller (A1)	
Pin	Wire # Color
1	042 VIO/ORN
2	093 RED/YEL
3	030 BRN/WHT
4	031 RED/VIO
5	106 GRA/VIO
6	111 BRN/GRN
7	115 RED/GRA
8	118 WHT/ORN
9	123 PINK
10	129 BLU/PINK
11	131 GRA/ORN
12	134 GRA/BLU
13	137 BRN/RED
14	139 VIO/BRN
15	144 BLK
16	142 BLK
17	250 GRN/ORN
18	149 BLK
19	154 BLK
20	156 BLK
21	159 BLK
22	---
23	059 VIO/RED
24	171 GRN/WHT
25	---
26	058 GRA
27	076 GRN/BRN
28	---
29	166 BLK
30	---
31	---
32	049 ORN/BLK
33	---
34	056 GRA/BLK
35	055 GRA/BLK

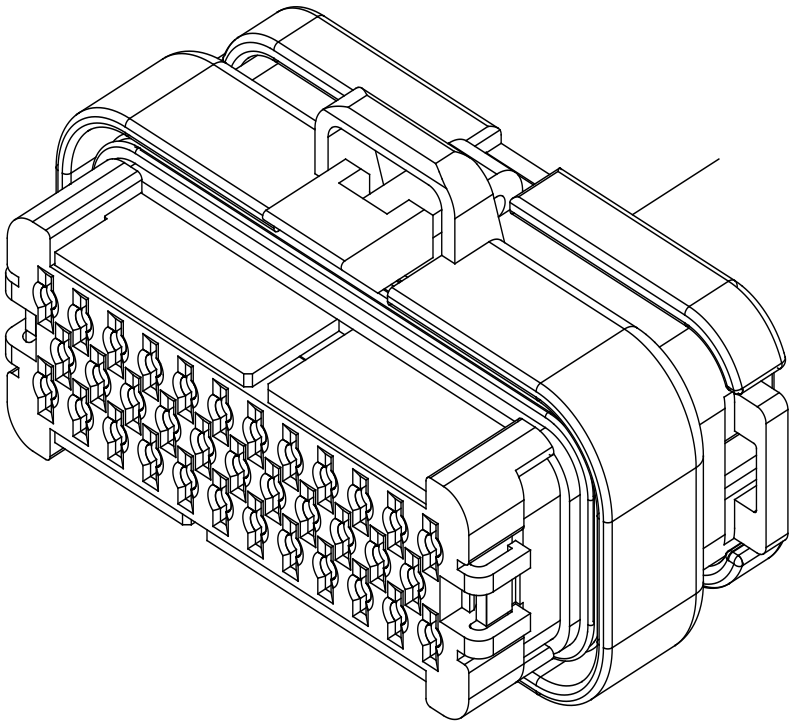




J3 **AMP 776164-4**
GRAY

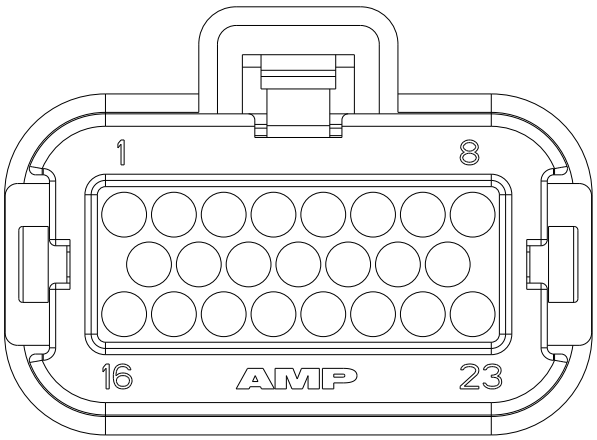
J4 - Drive Controller (A2)	
Pin	Wire # Color
1	185 ORN
2	---
3	---
4	---
5	---
6	126 VIO/GRN
7	186 BLK/PINK
8	187 TAN/RED
9	188 GRN/BLU
10	---
11	---
12	---
13	127 TAN/ORN
14	---
15	189 WHT/BLK
16	190 BRN/RED
17	---
18	191 VIO/BLK
19	---
20	---
21	---
22	---
23	192 YEL
24	---
25	193 VIO/WHT
26	194 PINK/RED
27	---
28	195 WHT/ORN
29	196 BLU/GRN
30	---
31	197 PINK/WHT
32	198 PINK/BLU
33	---
34	---
35	342 GRN

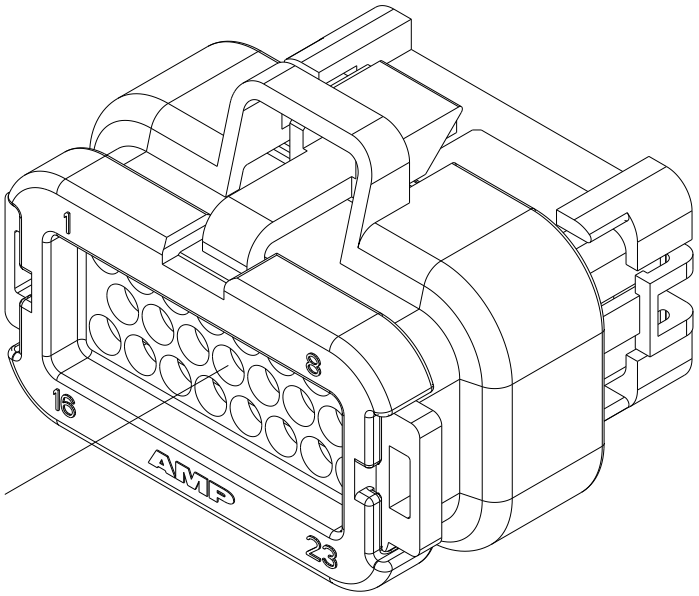




AMP 776164-1
BLACK

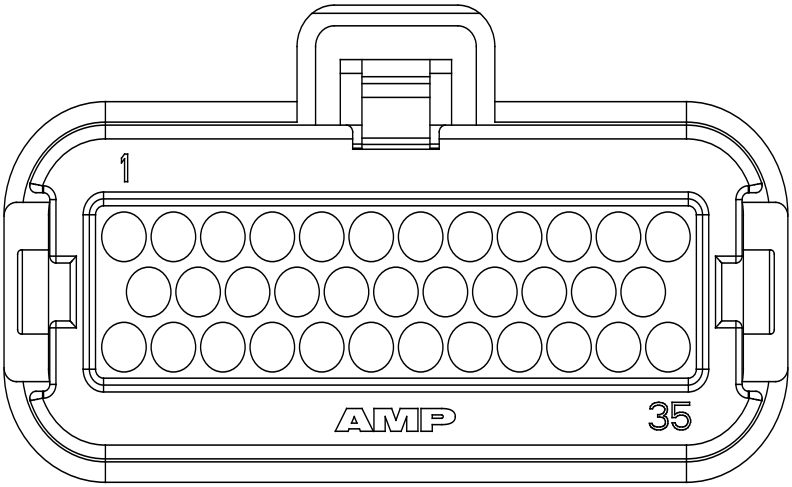
J5 - Steering Controller (A5)	
Pin	Wire # Color
1	083 GRA/ORN
2	199 BRN/WHT
3	200 ORN/BLK
4	201 BLK
5	202 WHT
6	203 BLU/GRA
7	---
8	204 BLK
9	---
10	308 RED/WHT
11	307 GRN/WHT
12	084 GRA/ORN
13	207 WHT/BLU
14	---
15	343 GRN
16	208 YEL/RED
17	309 BLU
18	073 VIO
19	210 ORN/RED
20	310 GRN/BLK
21	---
22	---
23	212 YEL

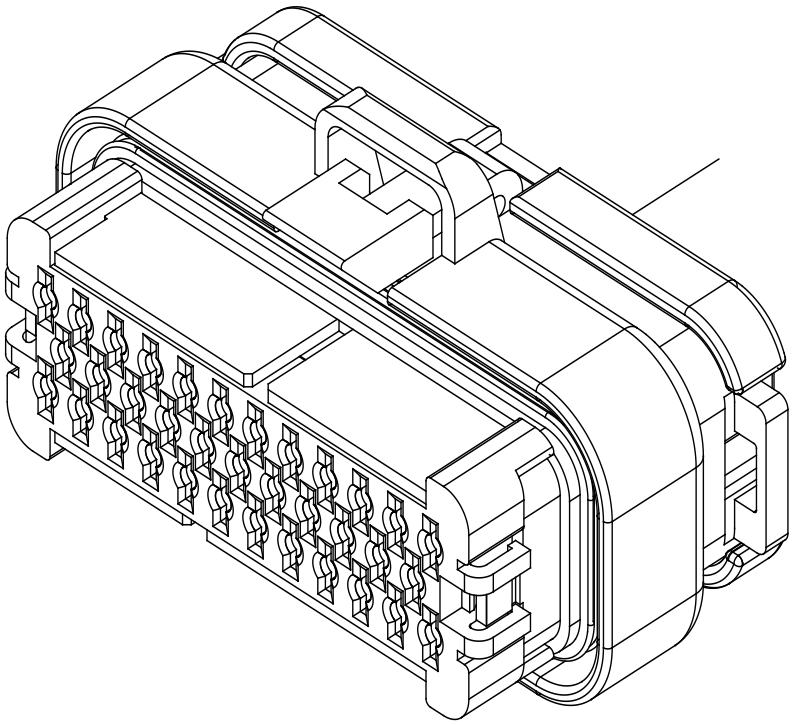




AMP 770680-1

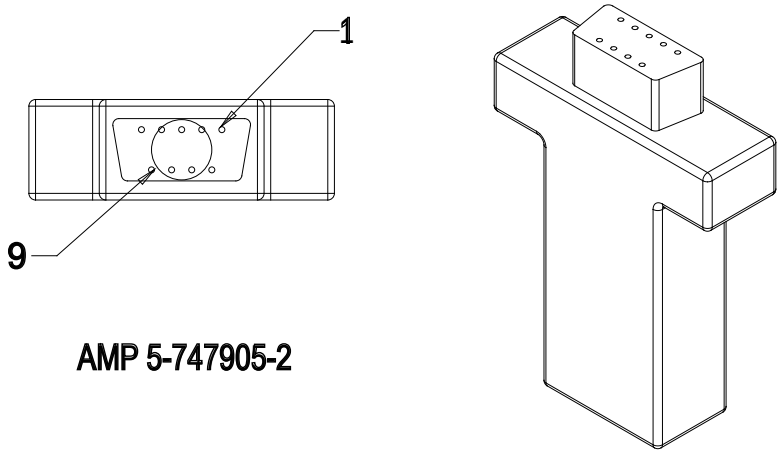
J7 - Main Machine Controller (A1)	
Pin	Wire # Color
1	092 GRN/BLU
2	095 GRN
3	099 YEL
4	102 GRA
5	108 GRA/YEL
6	112 TAN/WHT
7	117 YEL/RED
8	---
9	---
10	130 WHT/BRN
11	133 BLK
12	050 YEL/BRN
13	141 ORN
14	046 RED/BLK
15	035 GRA/YEL
16	143 WHT/GRA
17	145 ORN/GRA
18	151 YEL/VIO
19	155 VIO/GRN
20	---
21	161 RED/ORN
22	168 ORN/RED
23	170 YEL/WHT
24	172 BLU/YEL
25	174 VIO/WHT
26	---
27	178 BRN
28	---
29	184 RED/WHT
30	---
31	215 ORN/BLU
32	---
33	032 BLU/ BLK
34	033 GRA/GRN
35	034 TAN/RED



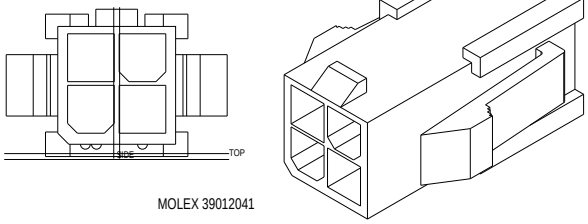


AMP 776164-1
BLACK

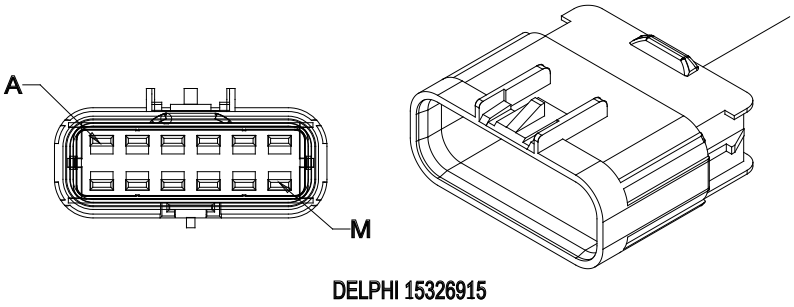
J8 - CAN Bus Connector	
Pin	Wire # Color
1	---
2	241 GRN
3	242 BLK
4	---
5	---
6	---
7	243 YEL
8	---
9	---



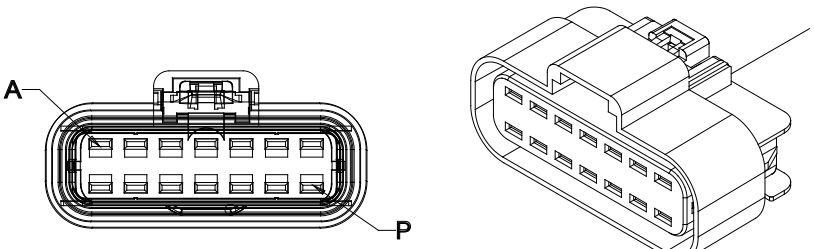
J10 - Drive Controller Programmer	
Pin	Wire
1	196 BLU/GRN
2	249 BLK/PINK
3	195 WHT/ORN
4	193 VIO/WHT



X1 - Hopper Harness Connector (X262)	
Pin	Wire
A	264 GRA
B	137 BRN/RED
C	143 WHT/GRA
D	244 BLK
E	151 YEL/VIO
F	240 BLK
G	070 ORN/GRN
H	248 BLK
J	067 VIO
K	150 BLK/RED
L	169 BRN
M	238 BLK/WHT

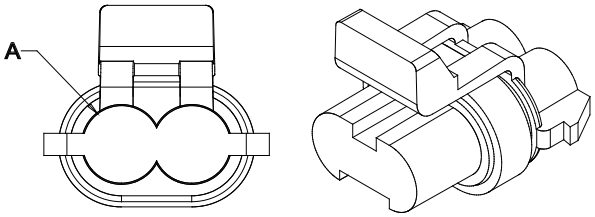


X2 - Hopper Harness Connector (X263)	
Pin	Wire
A	---
B	091 ORN/YEL
C	284 BLK/YEL
D	098 YEL/RED
E	106 GRA/VIO
F	250 GRN/ORN
G	111 BRN/GRN
H	115 RED/GRA
J	168 ORN/RED
K	235 BLK
L	170 YEL/WHT
M	239 BLK
N	071 WHT/RED
P	233 BLK



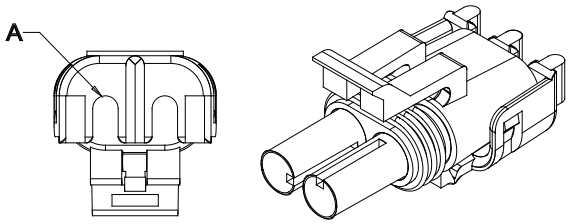
DELPHI 15326917

X17- Brush Motor, Right (M4)	
Pin	Wire # Color
A	251 BLK
B	152 BLU/YEL



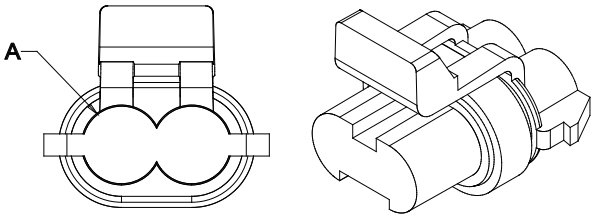
DELPHI 12052613

X18 - Brush Motor, Center (M3)	
Pin	Wire
A	109 GRA/BLK
B	254 BLK



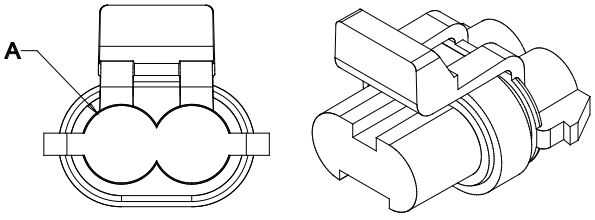
DELPHI 12015792

X19 - Brush Motor, Left (M2)	
Pin	Wire
A	113 WHT/ORN
B	253 BLK



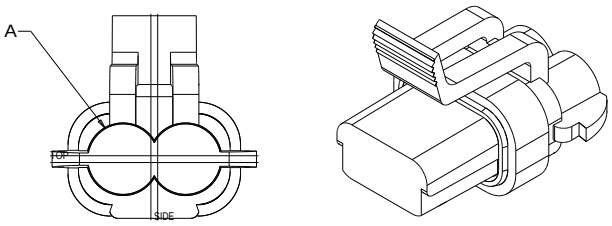
DELPHI 12052613

X20 - Shaker Motor (M14)	
Pin	Wire
A	267 VIO
B	268 BLK/RED



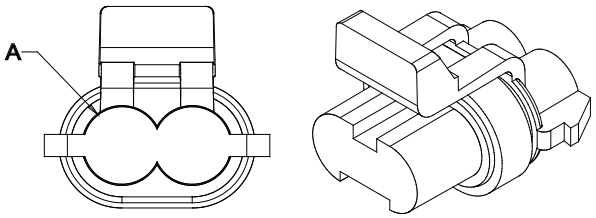
DELPHI 12052613

X21 - Dust Control Motor (M5)	
Pin	Wire
A	259 ORN/GRN
B	260 BLK



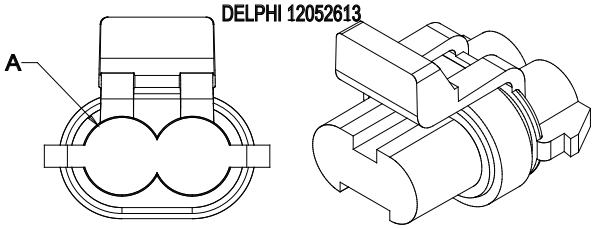
DELPHI 15300027

X22 - Squeegee Lift Actuator (M12)	
Pin	Wire
A	080 WHT/GRN
B	078 BLU/BRN



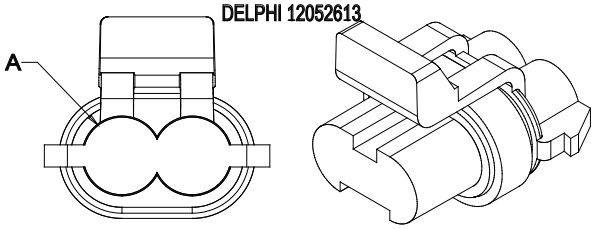
DELPHI 12052613

X23 - Vacuum Motor (M6)	
Pin	Wire
A	017 BLU/GRA
B	018 BLK



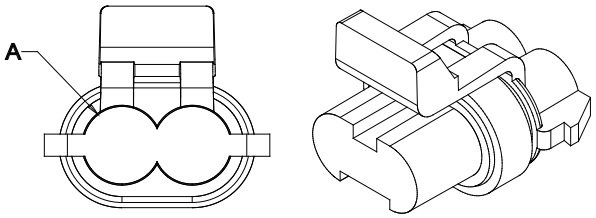
DELPHI 12052613

X24 - Vacuum Motor (M7)	
Pin	Wire
A	019 BLU/GRA
B	020 BLK



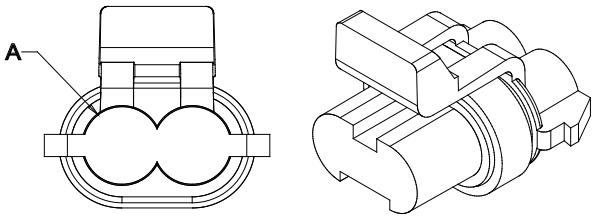
DELPHI 12052613

X25 - Main Broom Motor (M1)	
Pin	Wire
A	043 BRN/VIO
B	044 BLK



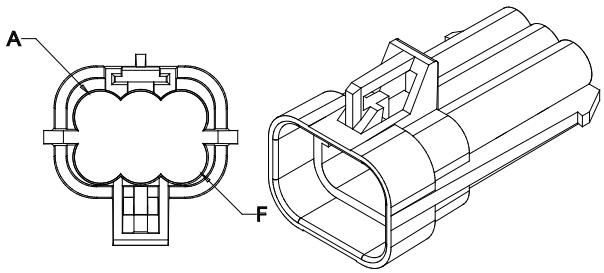
DELPHI 12052613

X26 - Left Side Broom Motor (M9)	
Pin	Wire
A	213 WHT/RED
B	214 BLK



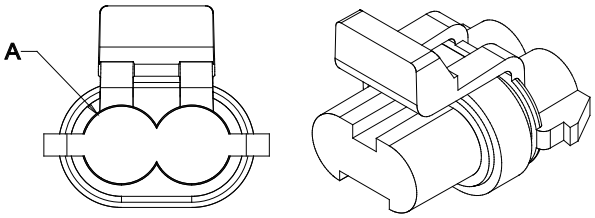
DELPHI 12052613

X27 - Main Broom Actuator (M21)	
Pin	**Wire**
A	030 BRN/WHT
B	031 RED/VIO
C	032 BLU/ BLK
D	033 GRA/GRN
E	034 TAN/RED
F	---



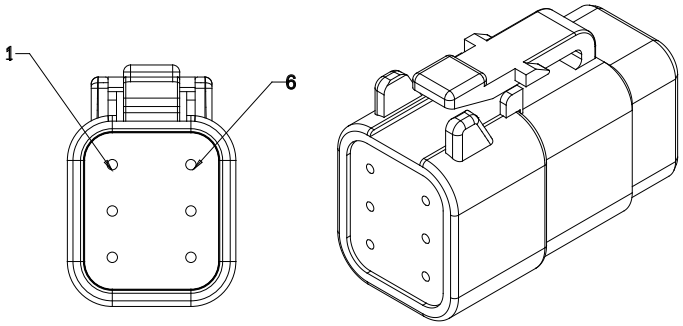
DELPHI 12124107

X28 - Right Side Broom Motor (M8)	
Pin	**Wire**
A	295 WHT/RED
B	297 BLK



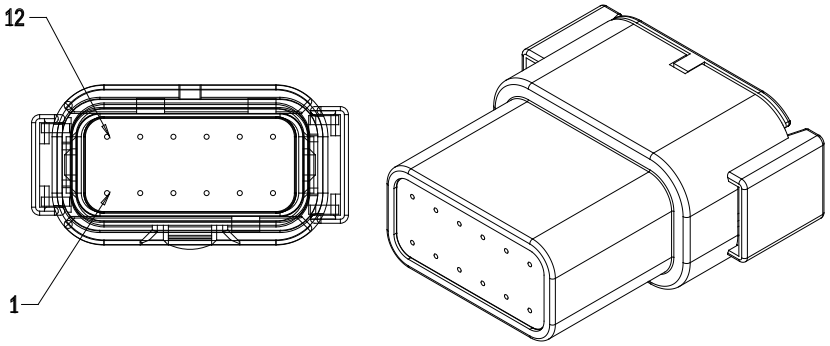
DELPHI 12052613

X97 - Steering Actuator (M16)	
Pin	**Wire**
1	299 ORN/BLK
2	202 WHT
3	203 BLU/GRA
4	208 YEL/RED
5	---
6	298 BLK



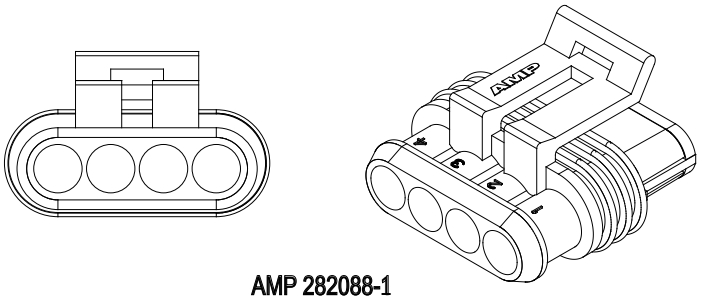
DEUTSCH DTM06-6S

X98 - Steering Wheel Sensor (E4)	
Pin	Wire
1	307 GRN/WHT
2	309 BLU
3	205 BLK
4	209 ORN/BLK
5	308 RED/WHT
6	310 GRN/BLK
7	206 BLK
8	211 ORN/BLK
9	199 BRN/WHT
10	329 GRA/ORN
11	---
12	---



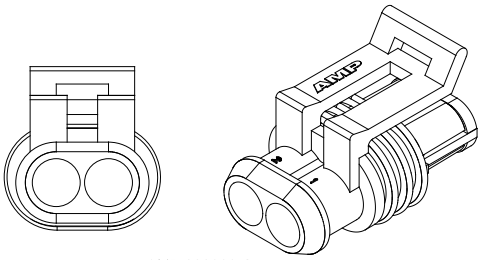
DEUTSCH DTM04-12PA

X99 - Wheel Drive Motor (M24)	
Pin	Wire
1	194 PINK/RED
2	198 PINK/BLU
3	197 PINK/WHT
4	288 BLK/PINK



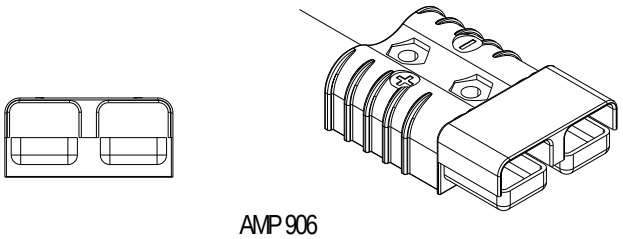
AMP 282088-1

X100 - Wheel Drive Motor (M24)	
Pin	Wire
1	187 TAN/RED
2	289 BLK/PINK



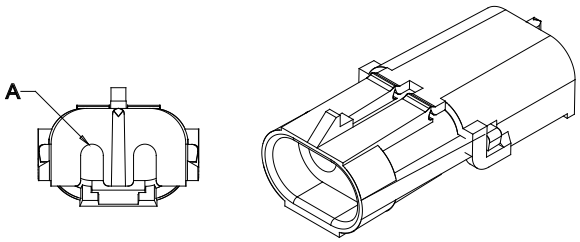
AMP 282080-1

X102 - Generator Harness Connector (X107)	
Pin	Wire
+	228 WELDING RED 3-0
-	235 WELDING BLK 3-0



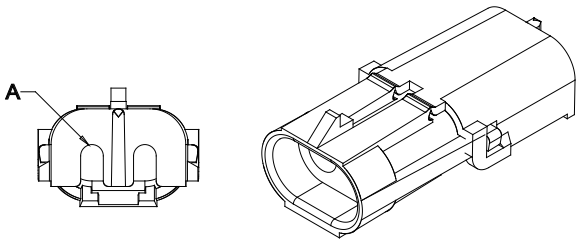
AMP 906

X105 - Steering Travel Limit Switch, Left (S17)	
Pin	Wire
A	210 ORN/RED
B	270 GRA/ORN



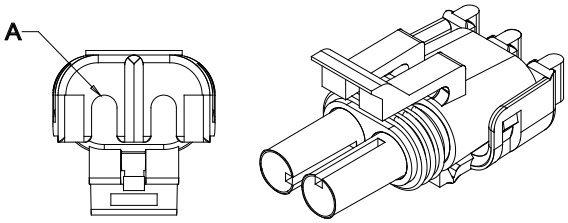
DELPHI 12010973

X106 - Steering Travel Limit Switch, Right (S16)	
Pin	Wire
A	207 WHT/BLU
B	277 GRA/ORN



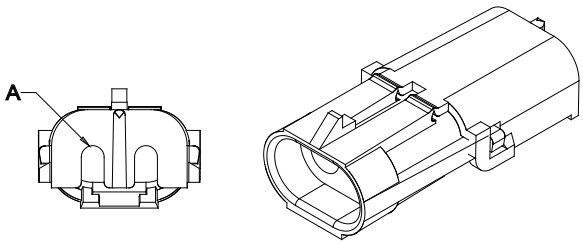
DELPHI 12010973

X109 - Side Broom Actuator (M13)	
Pin	Wire
A	282 GRA/VIO
B	283 GRN/ORN



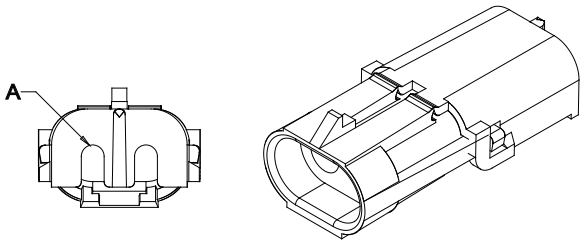
DELPHI 12015792

X111 - Pump, Solution Control (M19)	
Pin	Wire
A	269 GRA
B	093 RED/YEL



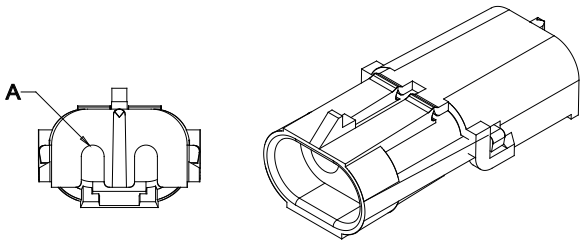
DELPHI 12010973

X118 - Pump, Extended Scrub (M25)	
Pin	Wire
A	041 GRA
B	042 VIO/ORN



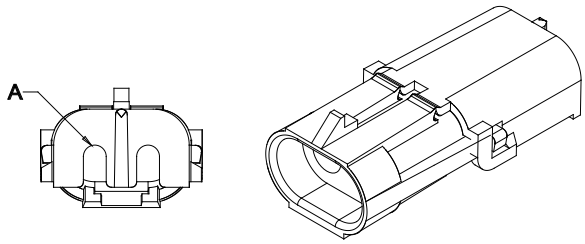
DELPHI 12010973

X120 - Low Pressure Pump (M23)	
Pin	Wire
A	266 GRA
B	171 GRN/WHT



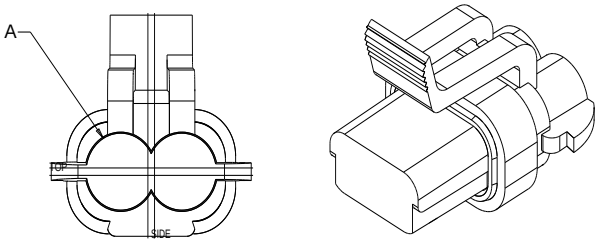
DELPHI 12010973

X122 - Dust Guard Pump (M22)	
Pin	Wire
A	147 GRA
B	148 BRN/RED



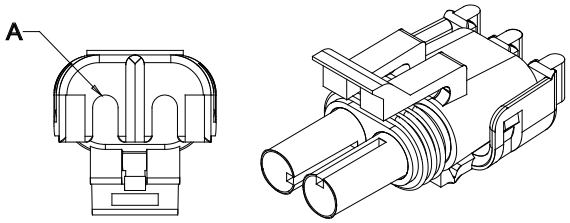
DELPHI 12010973

X124 - Dump Door Actuator Motor (M26)	
Pin	Wire
A	286 BRN/GRN
B	287 RED/GRA



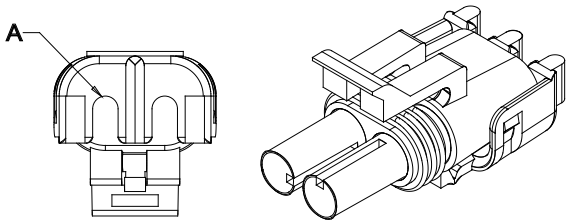
DELPHI 15300027

X126 - Hydraulic Pump, Hopper Lift (M10)	
Pin	Wire
A	175 BLU/YEL
B	177 RED/BRN



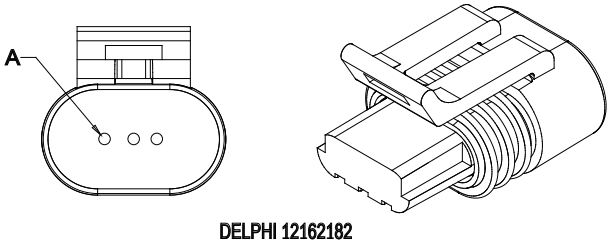
DELPHI 12015792

X140 - Dust Guard Valve (L2)	
Pin	Wire
A	086 GRA
B	087 BRN/RED



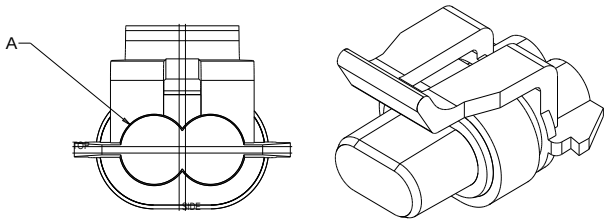
DELPHI 12015792

X145 - Drive Pedal Position Sensor (R1)	
Pin	Wire
A	189 WHT/BLK
B	190 BRN/RED
C	191 VIO/BLK



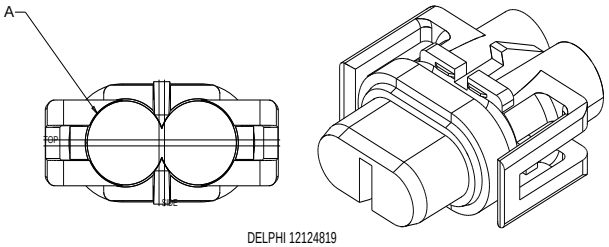
DELPHI 12162182

X153 - Tail Lamp, Left (LT9)	
Pin	Wire
A	010 TAN/BLK
B	011 BLK/YEL



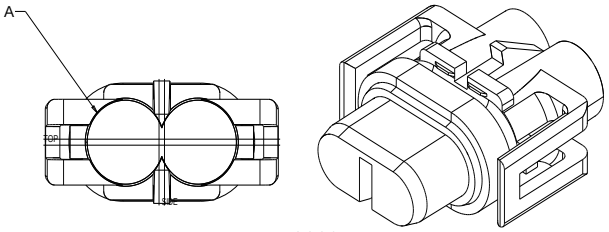
DELPHI 12052641

X154 - Tail Lamp, Right (LT5)	
Pin	Wire
A	012 TAN/BLK
B	025 BLK/YEL



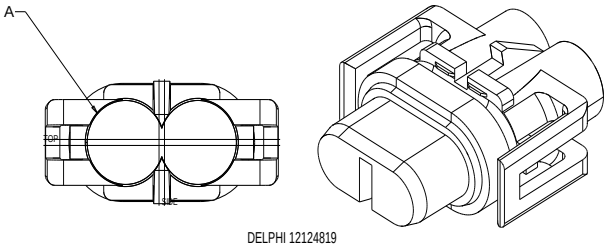
DELPHI 12124819

X161 - Left Head Lamp (LT3)	
Pin	Wire
A	236 BRN
B	237 BLK/WHT



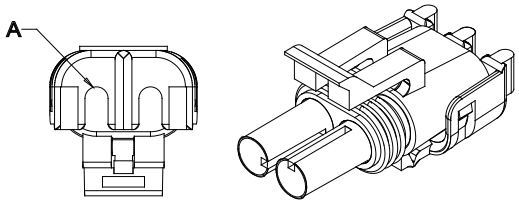
DELPHI 12124819

X162 - Right Head Lamp (LT2)	
Pin	Wire
A	274 BRN
B	276 BLK/WHT



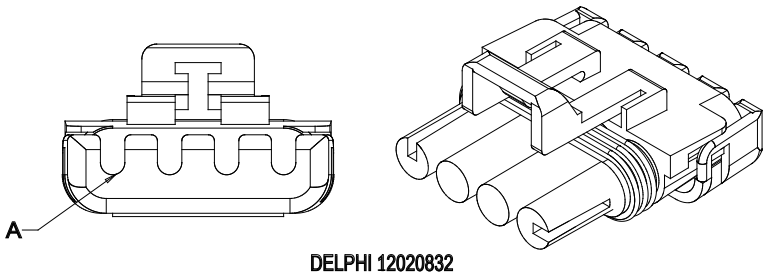
DELPHI 12124819

X165 - Curb Lamp	
Pin	Wire
A	273 BRN
B	275 BLK/WHT



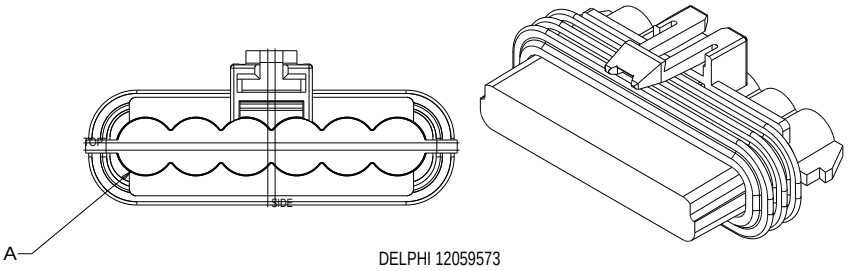
DELPHI 12015792

X166 - Tail Lamp Harness Connector (X239)	
Pin	Wire
A	094 ORN/BLU
B	107 TAN/BLK
C	285 BLK/YEL
D	101 YEL/GRN



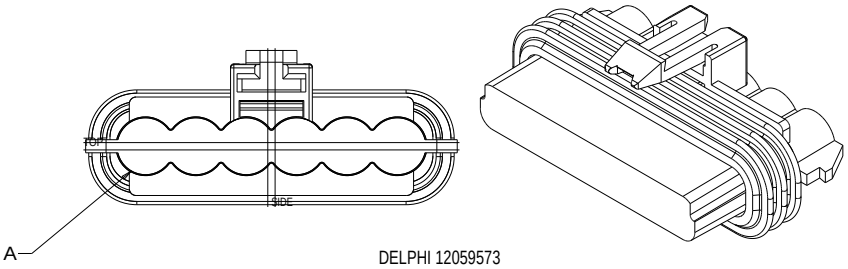
DELPHI 12020832

X172 - Splice Saver Connector Comb	
Pin	Wire
A	265 GRA
B	264 GRA
C	097 GRA
D	041 GRA
E	255 GRA
F	---



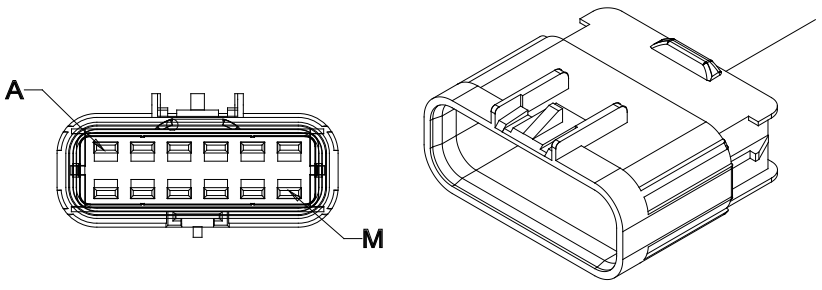
DELPHI 12059573

X173 - Splice Saver Connector Comb	
Pin	Wire
A	037 GRA
B	269 GRA
C	266 GRA
D	---
E	---
F	265 GRA



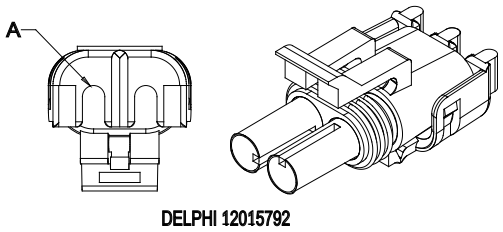
DELPHI 12059573

X175 - Main Harness Connector	
Pin	Wire
A	319 PINK
B	322 BLU/PINK
C	323 GRN/YEL
D	324 GRA
E	325 GRA/ORN
F	326 GRA/BLU
G	327 WHT/ORN
H	328 YEL/RED
J	330 TAN/WHT
K	334 BRN/ORN
L	335 ORN
M	---



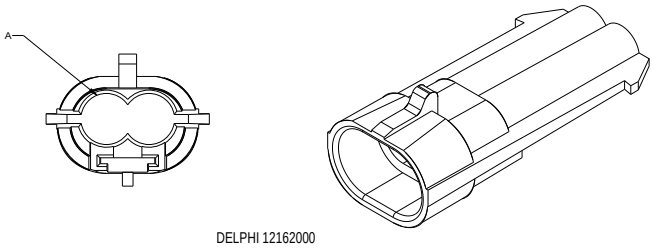
DELPHI 15326915

X178 - Back Up Alarm (H1)	
Pin	Wire
A	037 GRA
B	076 GRN/BRN



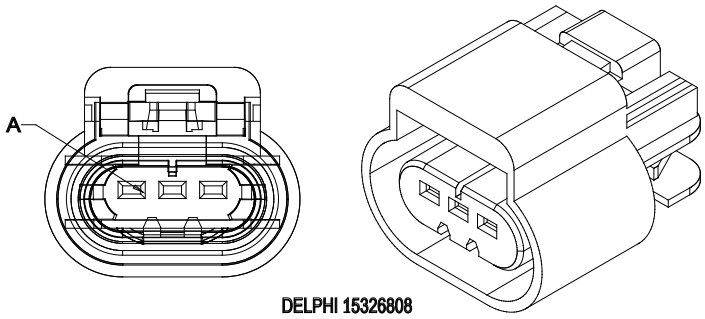
DELPHI 12015792

X180 - Stop/Turn Lamp, Left (LT9)	
Pin	Wire
A	023 ORN/BLU
B	009 BLK/YEL



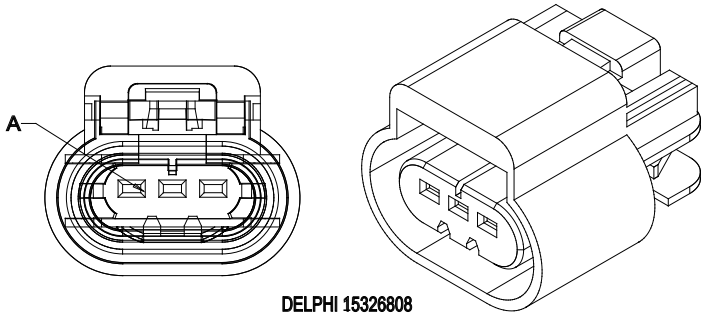
DELPHI 12162000

X181 - Broom Motor Current Sensor (B2)	
Pin	Wire
A	261 BLU/YEL
B	256 VIO/WHT
C	215 ORN/BLU



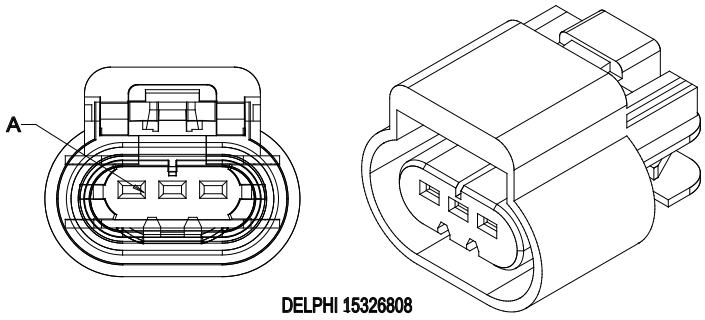
DELPHI 15326808

X182 - Vacuum Motor Current Sensor (B3)	
Pin	Wire
A	262 BLU/YEL
B	257 VIO/WHT
C	184 RED/WHT



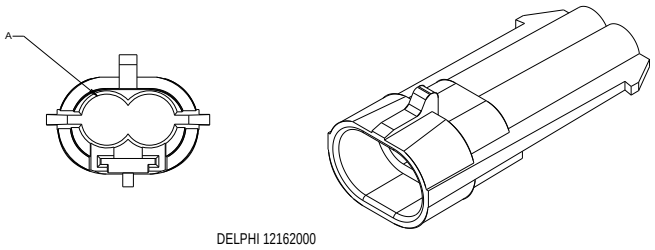
DELPHI 15326808

X183 - Brush Motor Current Sensor (B1)	
Pin	Wire
A	263 BLU/YEL
B	258 VIO/WHT
C	178 BRN



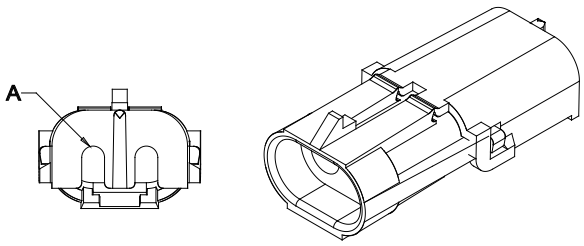
DELPHI 15326808

X184 - Stop/Turn Lamp, Right (LT11)	
Pin	Wire
A	014 YEL/GEN
B	024 BLK/YEL



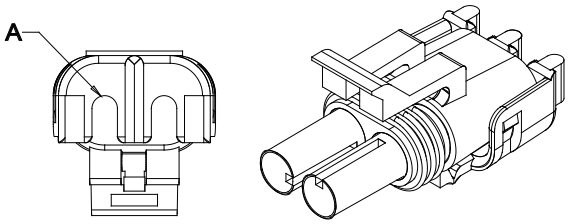
DELPHI 12162000

X187 - Battery Interlock Switch (S13)	
Pin	Wire
A	315 TAN
B	338 GRN/BLU



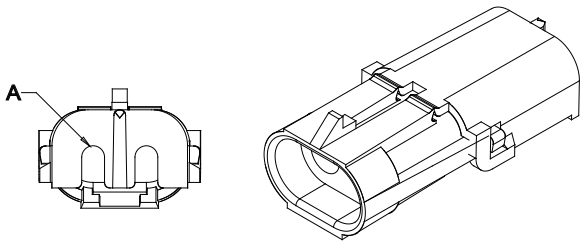
DELPHI 12010973

X190 - Solution Solenoid Valve (L1)	
Pin	Wire
A	157 YEL/ORN
B	089 VIO



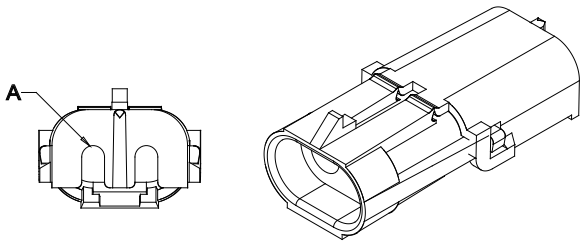
DELPHI 12015792

X202 - Brake Switch (S5)	
Pin	Wire
A	145 ORN/GRA
B	231 BLK



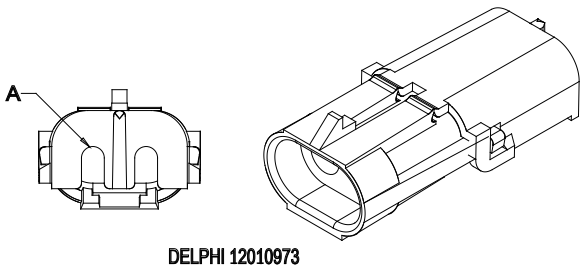
DELPHI 12010973

X204 - Hopper Interlock Switch (S3)	
Pin	Wire
A	046 RED/BLK
B	230 BLK



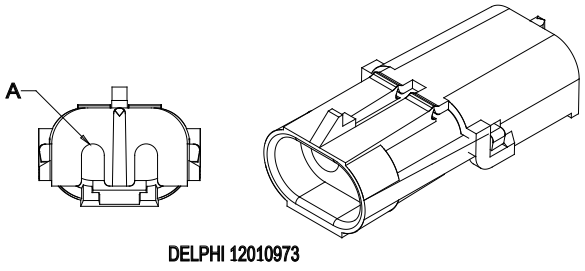
DELPHI 12010973

X236 - Dump Door Extend Limit Switch (S7)	
Pin	Wire
A	290 ORN/RED
B	291 BLK



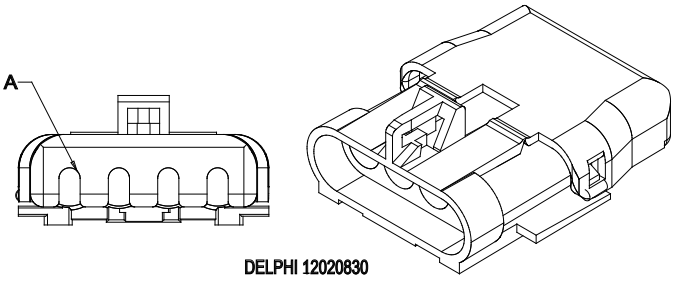
DELPHI 12010973

X238 - Dump Door Retract Limit Switch (S8)	
Pin	Wire
A	292 YEL/WHT
B	293 BLK



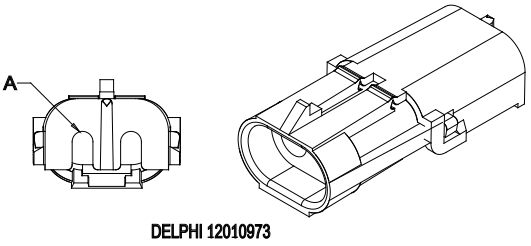
DELPHI 12010973

X239 - Main Harness Connector (X166)	
Pin	Wire
A	023 ORN/BLU
B	013 TAN/BLK
C	022 BLK/YEL
D	014 YEL/GRN



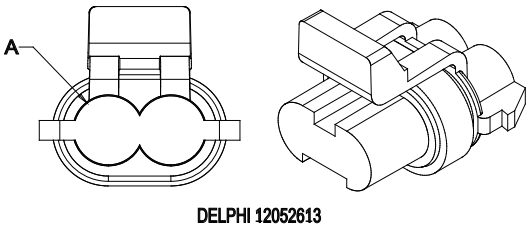
DELPHI 12020830

X255 - Scrub Deck Retract Limit Switch (S1)	
Pin	Wire
A	161 RED/ORN
B	229 BLK



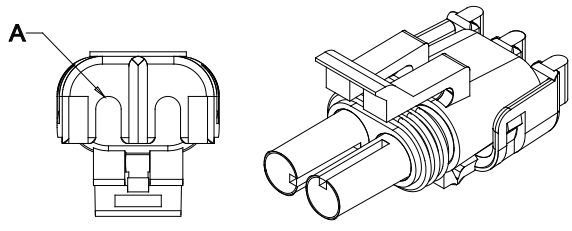
DELPHI 12010973

X256 - Scrub Deck Actuator Motor (M11)	
Pin	Wire
A	132 RED/GRN
B	135 YEL/GRA



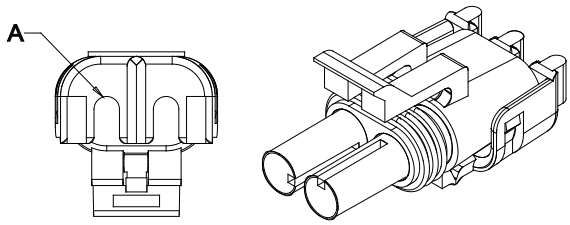
DELPHI 12052613

X257 - Beacon (LT10)	
Pin	Wire
A	220 VIO
B	234 BLK



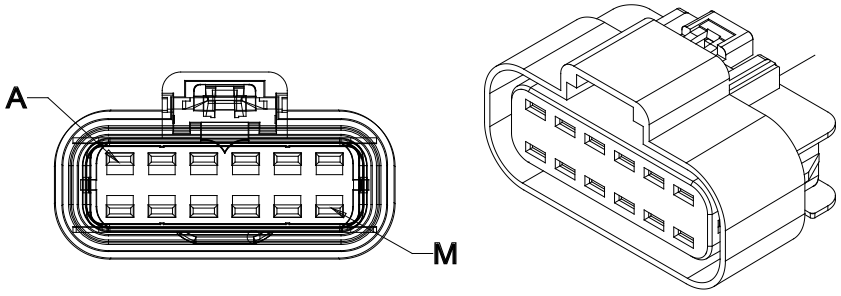
DELPHI 12015792

X258 - Trouble Light (LT1)	
Pin	Wire
A	316 YEL/BRN
B	232 BLK



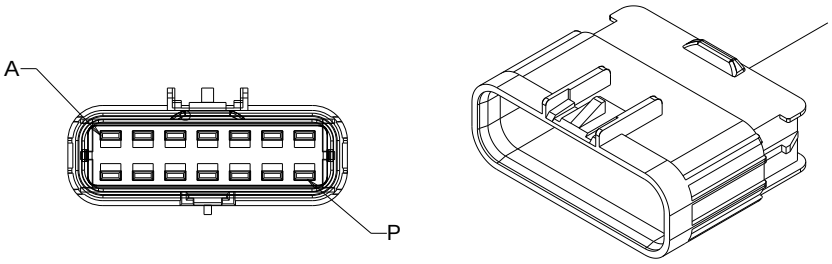
DELPHI 12015792

X262 - Main Harness Connector (X1)	
Pin	Wire
A	176 GRA
B	181 BRN/RED
C	223 WHT/GRA
D	224 BLK
E	225 YEL/VIO
F	226 BLK
G	259 ORN/GRN
H	260 BLK
J	267 VIO
K	268 BLK/RED
L	271 BRN
M	272 BLK/WHT



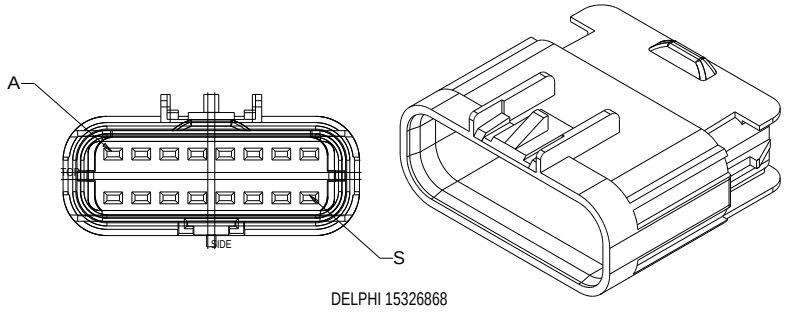
DELPHI 15326910

X263 - Main Harness Connector (X2)	
Pin	Wire
A	---
B	218 ORN/YEL
C	279 BLK/YEL
D	281 YEL/RED
E	282 GRA/VIO
F	283 GRN/ORN
G	286 BRN/GRN
H	287 RED/GRA
J	290 ORN/RED
K	291 BLK
L	292 YEL/WHT
M	293 BLK
N	294 WHT/RED
P	296 BLK

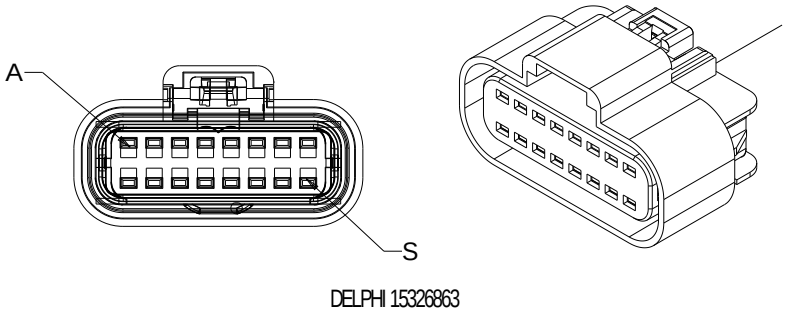


DELPHI 15326922

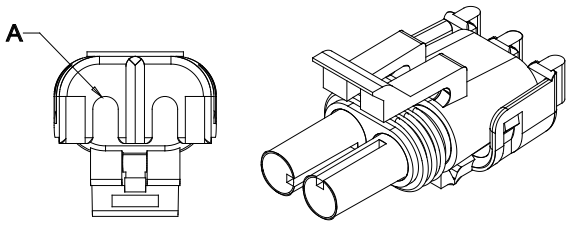
X265 - Engine Harness Connector	
Pin	Wire
A	321 PINK
B	341 PINK
C	318 BLK/RED
D	317 PINK/YEL
E	---
F	322 BLU/PINK
G	323 GRN/YEL
H	---
J	---
K	---
L	---
M	---
N	---
P	---
R	---
S	---



X266 - Engine Harness Connector	
Pin	Wire
A	---
B	---
C	324 GRA
D	---
E	---
F	---
G	---
H	---
J	325 GRA/ORN
K	326 GRA/BLU
L	---
M	---
N	---
P	---
R	---
S	---

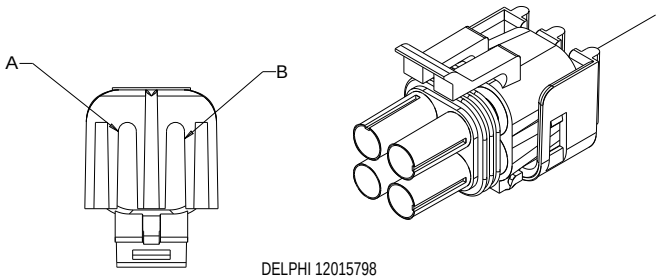


X268 - Extended Scrub Level Switch (S4)	
Pin	Wire
A	035 GRA/YEL
B	036 BLK



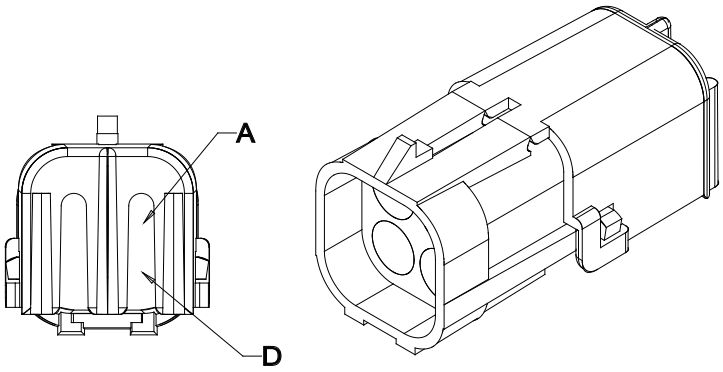
DELPHI 12015792

X270 - Main Harness Connector (X271)	
Pin	Wire
A	017 BLU/GRA
B	018 BLK
C	019 BLU/GRA
D	020 BLK



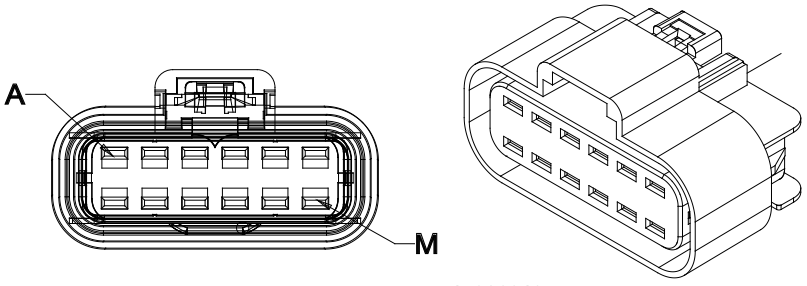
DELPHI 12015798

X271 - Vacuum Motor Harness (X270)	
Pin	Wire
A	026 BLU/GRA
B	027 BLK
C	028 BLU/GRA
D	029 BLK



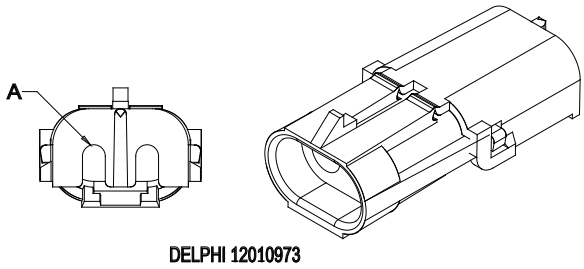
DELPHI 12015024

X274 - Engine Interface Harness Connector (X175)	
Pin	Wire
A	123 PINK
B	129 BLU/PINK
C	108 GRA/YEL
D	102 GRA
E	131 GRA/ORN
F	134 GRA/BLU
G	118 WHT/ORN
H	117 YEL/RED
J	112 TAN/WHT
K	355 ORN
L	222 BRN/ORN
M	---



DELPHI 15326910

X275 - Fuel Pump (M20)	
Pin	Wire
A	317 PINK/YEL
B	318 BLK/RED



Wiring Connections

K14 Safety Relay and K15 Auxiliary Relays

Early Style K14 Safety Relay

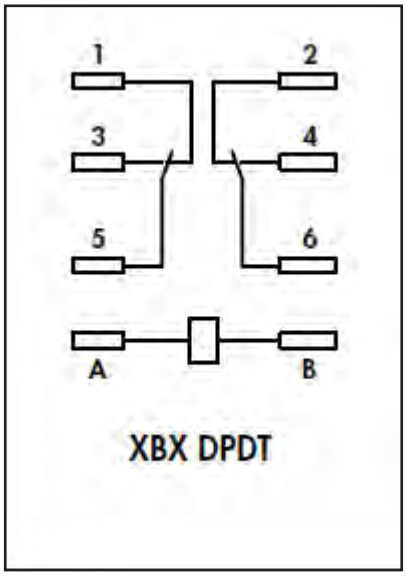
6 = GRA/ORN

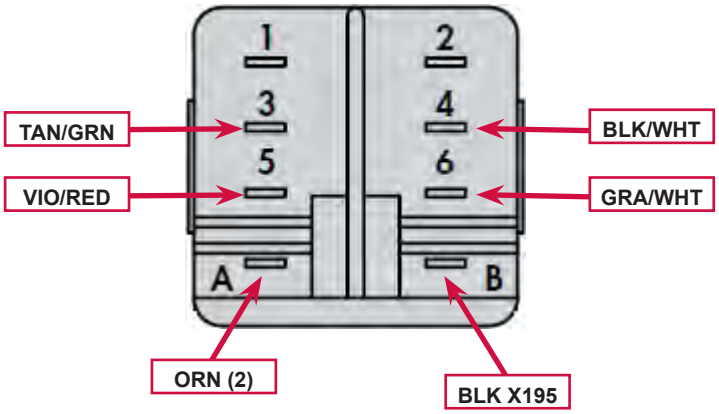
4 = PINK

A = VIO

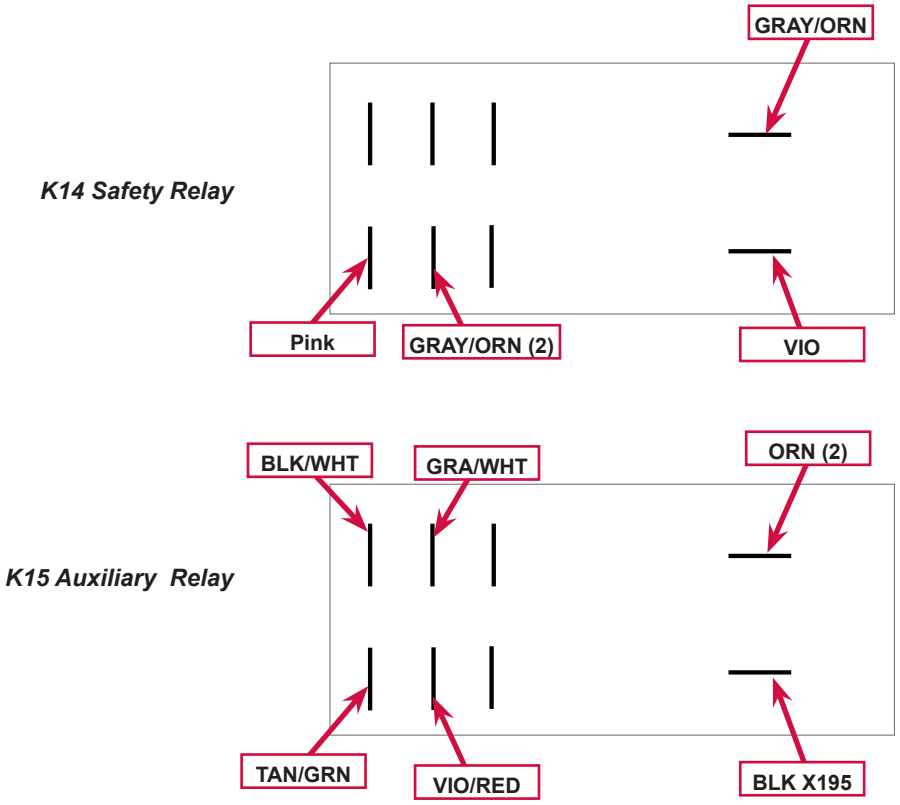
B = ORN or ORN/GRY

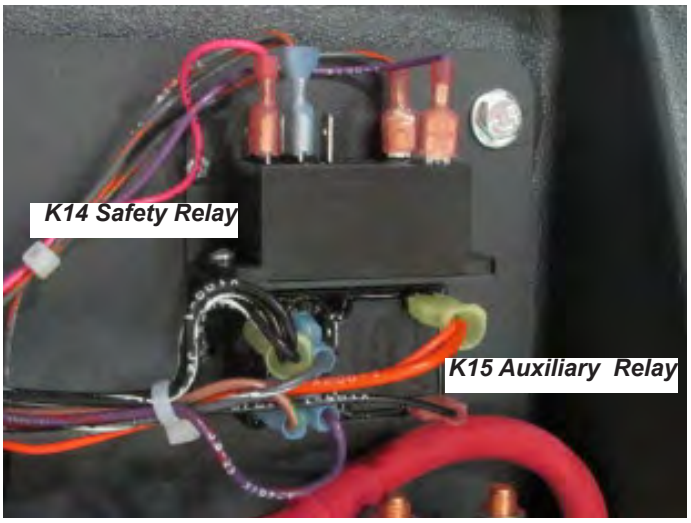
Early Style K15 Auxiliary Relay





Late style K14 Safety Relay and K15 Auxiliary Relay





Maintenance and Adjustments

Charging the Battery (Battery Model)

See User Manual

Generator Drive Belt

The generator drive belt tension is maintained by an auto-tensioner and does not require adjustment.

Troubleshooting

42 volt generator is not charging

Potential Causes

- Broken or slipping drive belt - Check the drive belt
- No power to voltage regulator terminal - Check for battery voltage (36v) to the voltage regulator connector
- Open or corroded cable connections - visually inspect cable connections
- Generator/Regulator assembly

Insufficient machine operation time (Battery Model)

Potential Causes

- Battery is not fully charged
- Loose or corroded cable connections
- Battery

Insufficient machine operation time with engine off (Hybrid models)

Potential Causes

- Battery is not fully charged
- Loose or corroded cable connections
- Battery

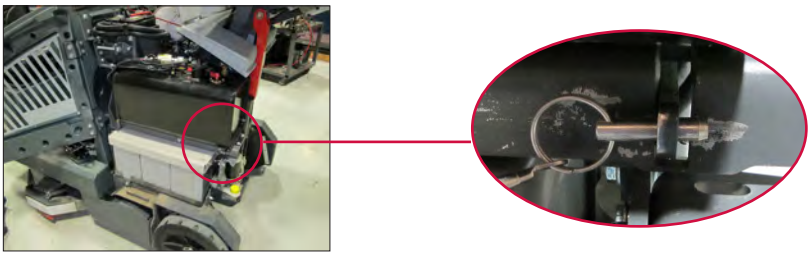
Removal and Installation

42 volt Generator Drive Belt

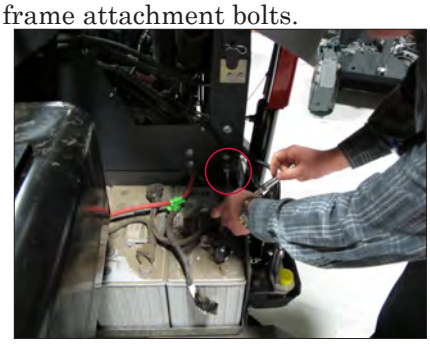
Note: Instructions are for both diesel and LPG models. Photos are of diesel.

1. Lift hopper up, engage hopper prop rod and then lower to safety lock position.
2. Open the side cover and remove the lower panel.

3. Remove the retaining pin and swing out the fuel tank.

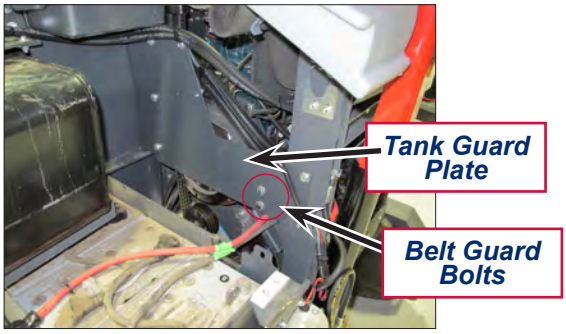


4. Remove the 36v battery pack top cover.
5. Disconnect the main battery negative and positive cables.
6. Remove the two battery pack tray to frame attachment bolts.



7. Slide the battery pack tray outboard to the end of the tether cable.

8. Remove the tank guard plate.

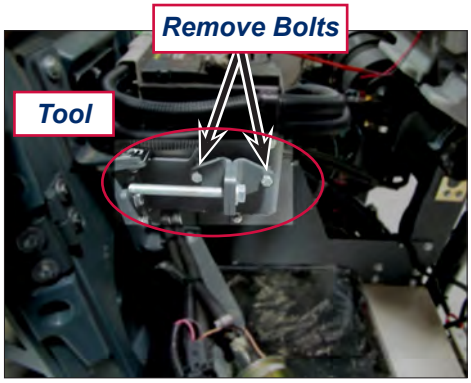


   a. Remove plate to frame bolts.

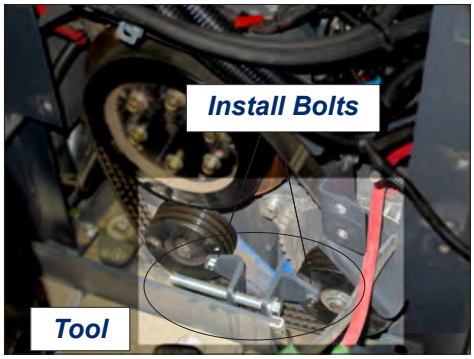
   b. Remove the plate to belt guard bolts.

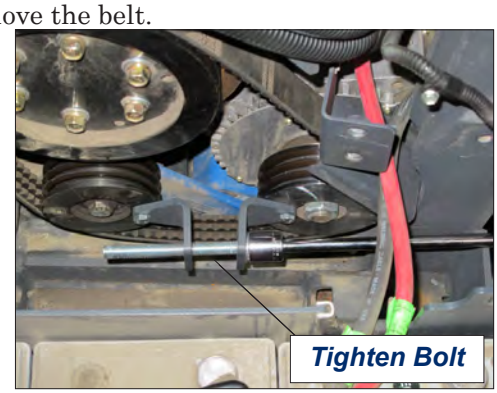
   c. Remove the “P” clamp cable and fuel line fasteners.

9. Remove the belt tension release tool from the side of the starting battery.



10. Using the bolts that had attached the tool to the battery tray, bolt one end of the tool to the tensioner pulley and bolt the other end to the generator pulley. Pull the two tool halves together by “tightening” the long bolt. This will compress the auto-tensioner “spring” and release the tension on the drive belt. Turn the bolt until there is enough slack to remove the belt.



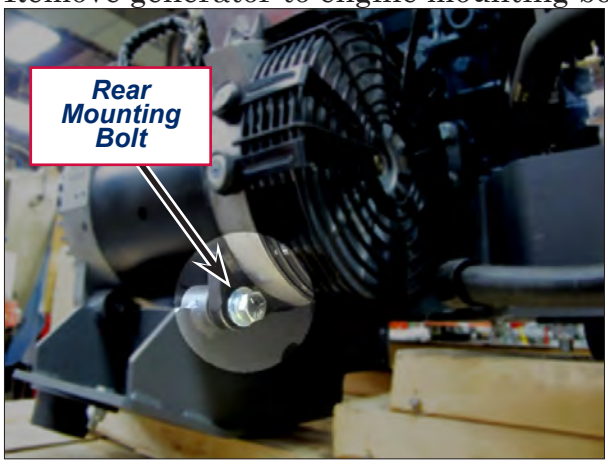


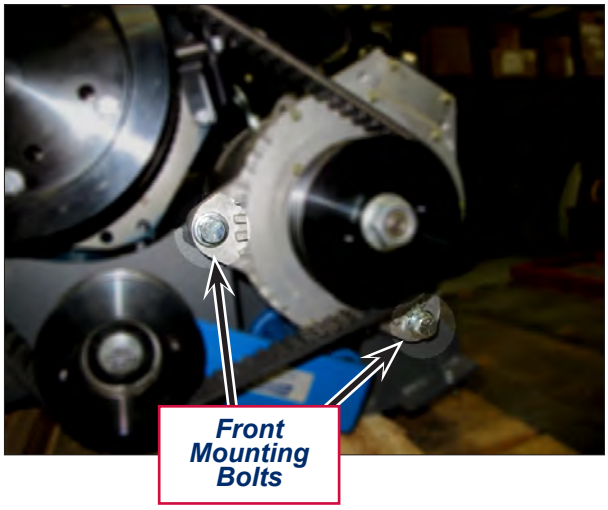
11. Remove the belt.

12. Reassemble in reverse order.

42 volt Generator

1. Remove Engine and Generator as an assembly. See relevant engine chapter.
2. Remove generator drive belt.
3. Label wiring for correct reassembly and then remove.
4. Support generator with a lift.
5. Remove generator to engine mounting bolts

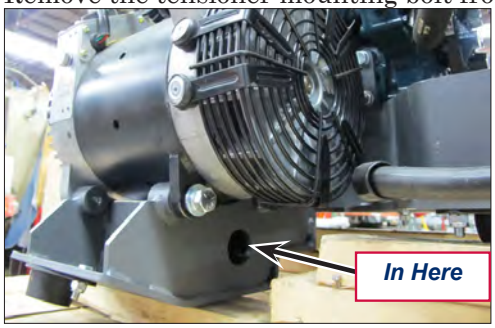




6. Remove generator.
7. Reassemble in reverse order.

Generator Drive Belt Tensioner

1. Remove Drive Belt.
2. Retract the tensioner tool bolt to relieve the spring tension.
3. Remove the tensioner tool.
4. Raise and lock hopper in place.
5. Remove lower rubber curtain fasteners to gain access to engine area and move the curtain aside.
6. Remove the tensioner mounting bolt from the back side of the generator mounting bracket. See photo.



7. Reassemble in reverse order.

Head Light bulb - Standard 12v Halogen

1. Disconnect headlight electrical connector

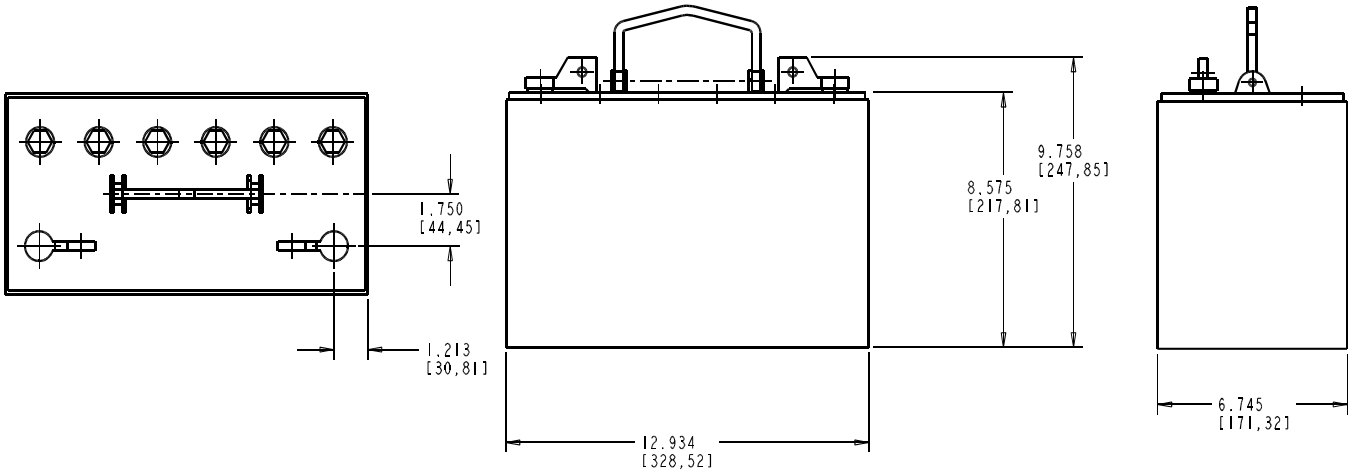
Caution! ***DO NOT install a replacement halogen bulb into the socket while the headlight is plugged in. If the configuration menu is set for LED headlights, up to 42 volts could be available to the headlights. Plugging the 12 volt halogen bulb into a 42 volt source could cause the bulb to shatter in your hand.***

2. Replace Bulb
3. Enter the ***Configuration Menu***, “Light Option and select “Standard Light”.
4. Re-connect the headlight electrical connector.

Specifications

Battery (Battery Model)

Capacity - 98 AH @ 20 HR



Low Voltage Cut Out

The low voltage cut out specification in use is set in the user options menu.

Menu #	Cut Out AT:	Restore Operation at:	Battery Type
1	1.75v per cell (31.5v total)	2.15v per cell (38.7v total)	Wet
2	1.83v per cell (32.9v total)	2.09v per cell (37.6v total)	Gel
3	1.75v per cell (31.5v total)	2.09v per cell (37.6v total)	(User Preference)

Battery Run Time (Battery powered machine)

Approx 5.4 hours (770 AH, 6 hr rate, and 900 AH 5 hr rate)

Auxiliary Relay

Winding Resistance: 652 Ohms

Auxiliary Contactor

Winding Resistance: 118 Ohms

Current Sensors

Amperage Measured	Voltage Output
120 A	4.5v
60 A	3.5v
45 A	3.25v
30 A	3.0v
15 A	2.75v
0 A	2.5v
-60 A	1.5v
-120 A	0.5v

Input/Output Table

Conn.	Pin	Wire	Desig.	Description	ID	Signal	Nominal Value	Black voltmeter lead on:
J2	1	091 ORN/ YEL	Output	Left Front Turn Lamp	LT7		12V OFF / 0V ON	B-(Ground)
J2	2	094 ORN/ BLU	Output	Left Rear Tail Lamp	LT9		12V OFF / 0V ON	B-(Ground)
J2	3	098 YEL/ RED	Output	Right Front Turn Lamp	LT4		12V OFF / 0V ON	B-(Ground)
J2	4	101 YEL/ GRN	Output	Right Rear Stop/Turn Lamp	LT11		12V OFF / 0V ON	B-(Ground)
J2	5	107 TAN/ BLK	Output	Tail Lamps	LT5 and LT6		12V OFF / 0V ON	B-(Ground)
J2	6	064 BLK/ YEL	Output	Dust Control Motor Contactor	K6	Grounds to energize	36V OFF / 0V ON	B-(Ground)
J2	7	119 BRN/ WHT	Output	Detergent Pump	M17	PWM SIGNAL (Reversing Polarity)	0-12V	J2-19
J2	8	080 WHT/ GRN	Output	Squeegee Actuator Motor	M12	Reversing Polarity	Battery 30.5- 38V Engine ON 37-40.5V	J2-9
J2	9	078 BLU/ BRN	Output	Squeegee Actuator Motor	M12	Reversing Polarity	Battery 30.5- 38V Engine ON 37-40.5V	J2-8
J2	10	132 RED/ GRN	Output	Scrub Deck Actuator Motor	M11	Reversing Polarity	Battery 30.5- 38V Engine ON 37-40.5V	J2-11
J2	11	135 YEL/ GRA	Output	Scrub Deck Actuator Motor	M11	Reversing Polarity	Battery 30.5- 38V Engine ON 37-40.5V	J2-10
J2	12	162 BLK	Ground Supply	Battery Negative			Battery 30.5- 38V Engine ON 37-40.5V	B+
J2	13	057 VIO	Power Supply	VACC 1		Power supply from Aux Contactor	Battery 30.5- 38V Engine ON 37-40.5V	B-(Ground)
J2	14	051 BLK/ ORN	Output	Auxiliary Contactor	K9	Grounds to energize	36V OFF / 0V ON	B-(Ground)
J2	15	163 BRN/ BLK	Output	Side Broom Motor Contactor	K8	Grounds to energize	36V OFF / 0V ON	B-(Ground)
J2	16	063 GRN/ GRA	Output	Main Broom Motor Contactor	K4	Grounds to energize	36V OFF / 0V ON	B-(Ground)
J2	17	045 BLU	Output	Vacuum Motor Contactor	K5	Grounds to energize	36V OFF / 0V ON	B-(Ground)
J2	18	150 BLK/ RED	Output	Shaker Motor ground	M14	PWM SIGNAL (half second cycles)	Battery 30.5- 38V Engine ON 37-40.5V	B-(Ground)
J2	19	116 WHT/ YEL	Output	Detergent Pump	M17	PWM SIGNAL (Reversing Polarity)	0-12V	J2-7

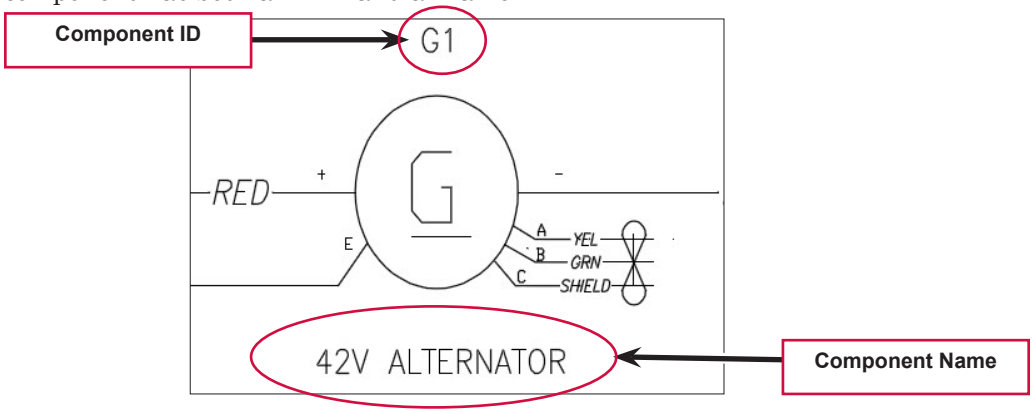
Conn.	Pin	Wire	Desig.	Description	ID	Signal	Nominal Value	Black voltmeter lead on:
J2	20	157 YEL/ ORN	Output	Solution Solenoid Valve Grounds to energize	L1	ON/OFF signal		
J2	21	160 BLU/ VIO	Output	Detergent Pump	M18	PWM SIGNAL (Reversing Polarity)	0-12V	J2-32
J2	22	167 BLK/ YEL	Output	Lamps Common		Regulated 12V supply	12	B-(Ground)
J2	23	169 BRN	Output	Head Lamps and Curb Lamp PWM ground to turn on lights	LT2, LT3, LT8	PWM ground to turn on lights	0	B-(Ground)
J2	24	039 ORN/ RED	Output	Hydraulic Pump Motor Contactor Grounds to energize	K12			
J2	25	047 YEL/ BLU	Output	Left Brush Motor Contactor	K1	Grounds to energize	36V OFF / 0V ON	B-(Ground)
J2	26	015 WHT/ VIO	Output	Center Brush Motor Contactor	K2	Grounds to energize	36V OFF / 0V ON	B-(Ground)
J2	27	061 GRA/ RED	Output	Right Brush Motor Contactor	K3	Grounds to energize	36V OFF / 0V ON	B-(Ground)
J2	28	038 BLU/ ORN	Output	Hydraulic Pump Motor Contactor (K11) Grounds to energize	K11	Grounds to energize	36V OFF / 0V ON	B-(Ground)
J2	29	---						
J2	30	---						
J2	31	---						
J2	32	221 GRA/ BLU	Output	Detergent Pump	M18	PWM SIGNAL (Reversing Polarity)	0-12V	J2-21
J2	33	---						
J2	34	054 BLK/ WHT	Power Supply	VACC6a		Power supply from Aux Relay	36/40.5	
J2	35	053 BLK/ WHT	Power Supply	VACC6b		Power supply from Aux Relay	36/40.5	
J3	1	042 VIO/ ORN	Output	Extended Scrub Pump	M25	PWM ground	0-36V	
J3	2	093 RED/ YEL	Output	Solution Control Pump	M19	PWM ground	0-36V	
J3	3	030 BRN/ WHT	Output	Main Broom Actuator Reversing polarity driver	M21	PWM SIGNAL (Reversing Polarity)	0-36V	J3-4
J3	4	031 RED/ VIO	Output	Main Broom Actuator Reversing polarity driver	M21	PWM SIGNAL (Reversing Polarity)	0-36V	J3-3
J3	5	106 GRA/ VIO	Output	Side Broom Actuator Reversing polarity driver	M13	Reversing Polarity	Battery 30.5- 38V Engine ON 37-40.5V	J3-17
J3	6	111 BRN/ GRN	Output	Dump Door Actuator	M26	Reversing polarity driver	0-36V	J3-7
J3	7	115 RED/ GRA	Output	Dump Door Actuator Reversing polarity driver	M26	Reversing polarity driver	0-36V	J3-6
J3	8	118 WHT/ ORN	Output	High Pressure Pump Clutch Coil	Y1	High Side Driver Engine 12V	12V	B-(Ground)
J3	9	123 PINK	Output	Ignition On Output 12v out to engine system		High Side Driver Engine 12V	12V	
J3	10	129 BLU/ PINK	Output	Start Output 12v out to starter		High Side Driver Engine 12V	12V	

Conn.	Pin	Wire	Desig.	Description	ID	Signal	Nominal Value	Black voltmeter lead on:
J3	11	131 GRA/ ORN	Output	Throttle 2 Output		High Side Driver Engine 12V	0V or 12V	
J3	12	134 GRA/ BLU	Output	Throttle 1 Output		High Side Driver Engine 12V	0V or 12V	
J3	13	137 BRN/ RED	Output	Dust Guard Control (Pump and Valve)	L2, M22	Grounds to turn both on	0V	B-(Ground)
J3	14	139 VIO/ BRN	Output	Horn Ground to turn on	H2	Grounds to energize	0V	B-(Ground)
J3	15	144 BLK	Ground Supply	Battery Negative				
J3	16	142 BLK	Ground Supply	Battery Negative				
J3	17	250 GRN/ ORN	Output	Side Broom Actuator Reversing polarity driver	M13	Reversing Polarity	Battery 30.5- 38V Engine ON 37-40.5V	J3-5
J3	18	149 BLK	Ground Supply	Battery Negative				
J3	19	154 BLK	Ground Supply	Battery Negative				
J3	20	156 BLK	Ground Supply	Battery Negative				
J3	21	159 BLK	Ground Supply	Battery Negative				
J3	22	---						
J3	23	059 VIO/ RED	Power Supply	12V supply		Power supply from starting battery	12V	B-(Ground)
J3	24	171 GRN/ WHT	Output	Low Pressure Pump	M23	Grounds to energize Also requires internal pressure switch in pump	0V	B-(Ground)
J3	25	---						
J3	26	058 GRA	Power Supply	VACC2		Power supply from Aux Contactor	36V	B-(Ground)
J3	27	076 GRN/ BRN	Output	Backup Alarm	H1	Grounds to energize	0V	B-(Ground)
J3	28	---						
J3	29	166 BLK	Ground Supply	Battery Negative				
J3	30	---						
J3	31	---						
J3	32	049 ORN/ BLK	Output	Glow Plug Output		High Side Driver Engine 12V	12V	B-(Ground)
J3	33	---						
J3	34	056 GRA/ BLK	Power Supply	VACC3a		Power supply from Aux Contactor	36V	B-(Ground)
J3	35	055 GRA/ BLK	Power Supply	VACC3b		Power supply from Aux Contactor	36V	B-(Ground)
J7	1	092 GRN/ BLU	Input	Interlock Switch Input		Logic Input	36V	B-(Ground)
J7	2	095 GRN	Communi-cation	CAN Bus Low		Digital Signal	0 or 5V	B-(Ground)
J7	3	099 YEL	Communi-cation	CAN Bus High		Digital Signal	0 or 5V	B-(Ground)
J7	4	102 GRA	Output	Run Signal Input		Engine Logic Input	12 V Engine Running	B-(Ground)
J7	5	108 GRA/ YEL	Input	Engine Coolant Temperature		Logic Input	5V	
J7	6	112 TAN/ WHT	Input	Fuel Level Sender	S12	Analog Signal		
J7	7	117 YEL/ RED	Input	Low LP Pressure Switch	S11	Logic Input		
J7	8	---						

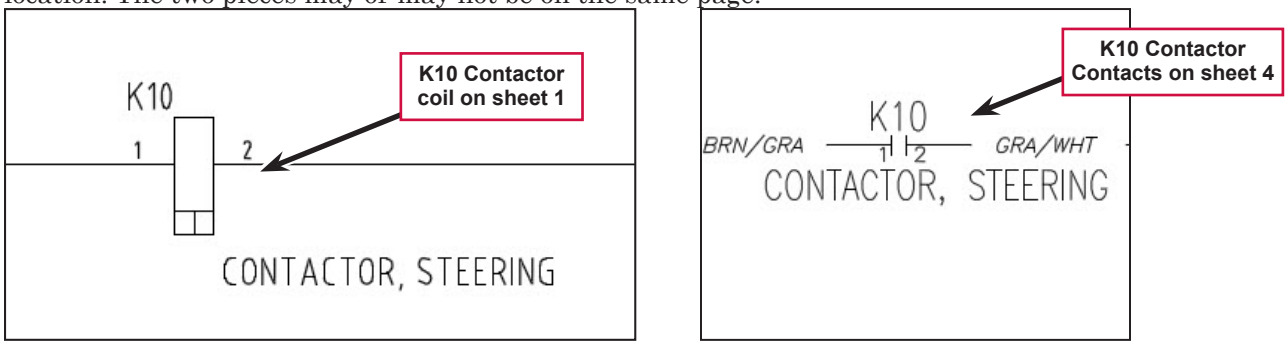
Conn.	Pin	Wire	Desig.	Description	ID	Signal	Nominal Value	Black voltmeter lead on:
J7	9	---						
J7	10	130 WHT/ BRN	Output	12v	A3	Power out to Control Panel	12V	B-(Ground)
J7	11	133 BLK	Output	B-	A3	Ground for Control Panel		
J7	12	050 YEL/ BRN	Special	Suppression Diode			36V	B-(Ground)
J7	13	141 ORN	Power Supply	Key Switch On Input	S14	Power supply	36V	B-(Ground)
J7	14	046 RED/ BLK	Input	Hopper Interlock Switch	S3	Logic Input	0 or 5V	B-(Ground)
J7	15	035 GRA/ YEL	Input	Extended Scrub Level Switch	S4	Logic Input	0 or 5V	
J7	16	143 WHT/ GRA	Input	Dust Control Filter Switch	S6	Logic Input	0 or 5V	
J7	17	145 ORN/ GRA	Input	Brake Switch	S5	Logic Input	0 or 5V	B-(Ground)
J7	18	151 YEL/ VIO	Input	Hopper Fire Switch	S10	Logic Input	0 or 5v	B-(Ground)
J7	19	155 VIO/ GRN	Input	Key Switch Start Input	S14	Logic Input	0 or 36V	B-(Ground)
J7	20	---						
J7	21	161 RED/ ORN	Input	Scrub Deck Retract Limit Switch	S1	Logic Input	0 or 5V	B-(Ground)
J7	22	168 ORN/ RED	Input	Hopper Dump Door Extend Limit Switch	S7	Logic Input	0 or 5V	B-(Ground)
J7	23	170 YEL/ WHT	Input	Hopper Dump Door Retract Limit Switch	S8	Logic Input	0 or 5V	B-(Ground)
J7	24	172 BLU/ YEL	Output	+5V		5v Power out to Current Sensors	5V	B-(Ground)
J7	25	174 VIO/ WHT	Output	B-		Ground for Current Sensors	0V	B-(Ground)
J7	26	---						
J7	27	178 BRN	Input	Brush Motor Current Sense	B1	Analog Signal	2.5 - 4.7	B-(Ground)
J7	28	---						
J7	29	184 RED/ WHT	Input	Vacuum Motor Current Sense	B3	Analog Signal	2.5 - 4.7	B-(Ground)
J7	30	---						
J7	31	215 ORN/ BLU	Input	Broom Motor Current Sense	B2	Analog Signal	2.5 - 4.7	B-(Ground)
J7	32	---						
J7	33	032 BLU/ BLK	Input	POT High	R4	Power supply for Main Broom Actuator Position Sensor	3.3V	B-(Ground)
J7	34	033 GRA/ GRN	Input	Wiper	R4	Main Broom Actuator Position Sensor input	0 to 3.3V	B-(Ground)
J7	35	034 TAN/ RED	Input	POT Low	R4	B- for Main Broom Actuator Position Sensor	0V	B-(Ground)

Wiring Diagrams

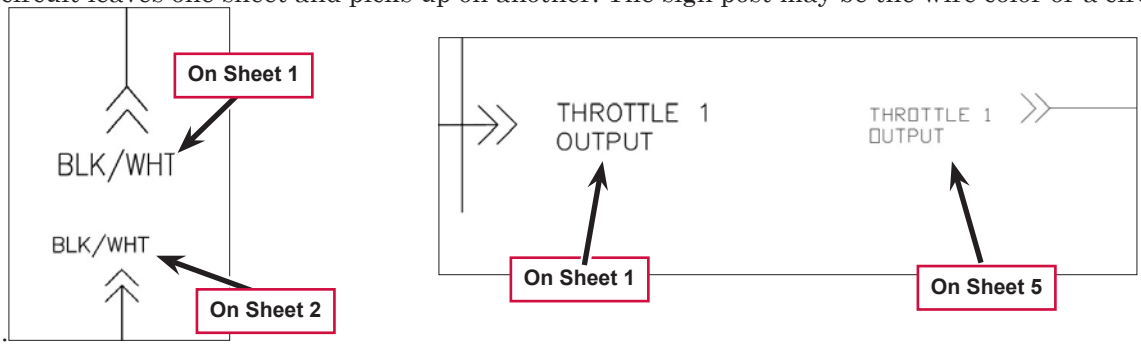
Wiring diagrams show how electrical components are connected together and to a large degree "how things work". They do not show where things are located. Here are some tips when using these diagrams. Every component has both an "ID" and a "name"



Typically relays (and contactors) are "split up" so that the relay winding is separated from the contacts. The "control" side of the relay is shown in one location and the "load" side of the relay is shown in another location. The two pieces may or may not be on the same page.



When a circuit breaks across sheets there is a "sign post" at both ends to help you quickly identify where the circuit leaves one sheet and picks up on another. The sign post may be the wire color or a circuit description.



The wiring diagrams show when a circuit passes through an in-line connector and identifies the two halves of the connector. If you need to locate one of these connectors, see the ***Harness to Harness Connector Locations*** section. To find a connector that plugs into a component, see the ***Component Locations*** section to locate the component then follow the wire lead (if there is one) to the connector. If you need more detailed information about what a multi-pin connector looks like and where the wires are located in the connector, see the ***Connector Pin-Outs*** section.

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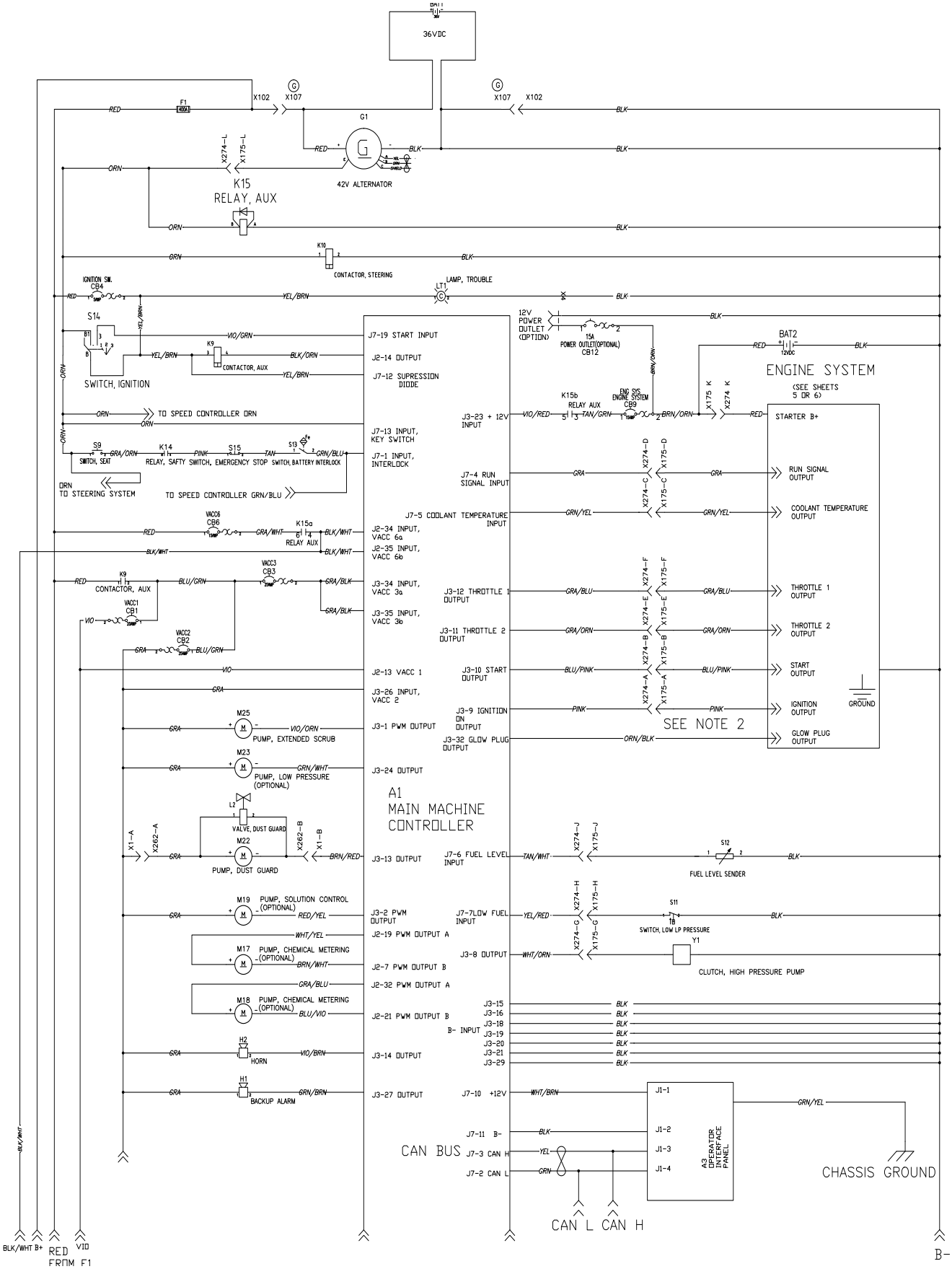
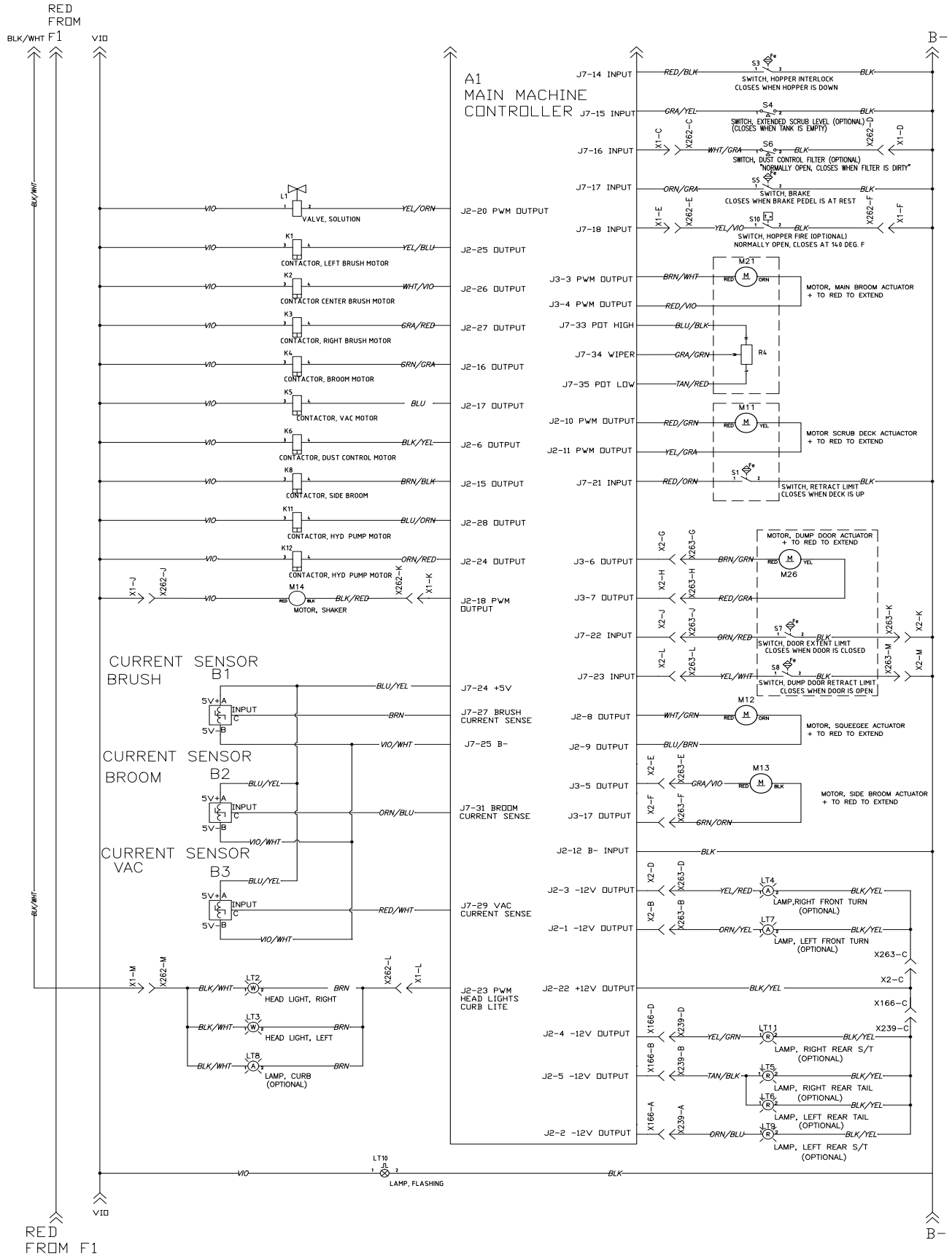
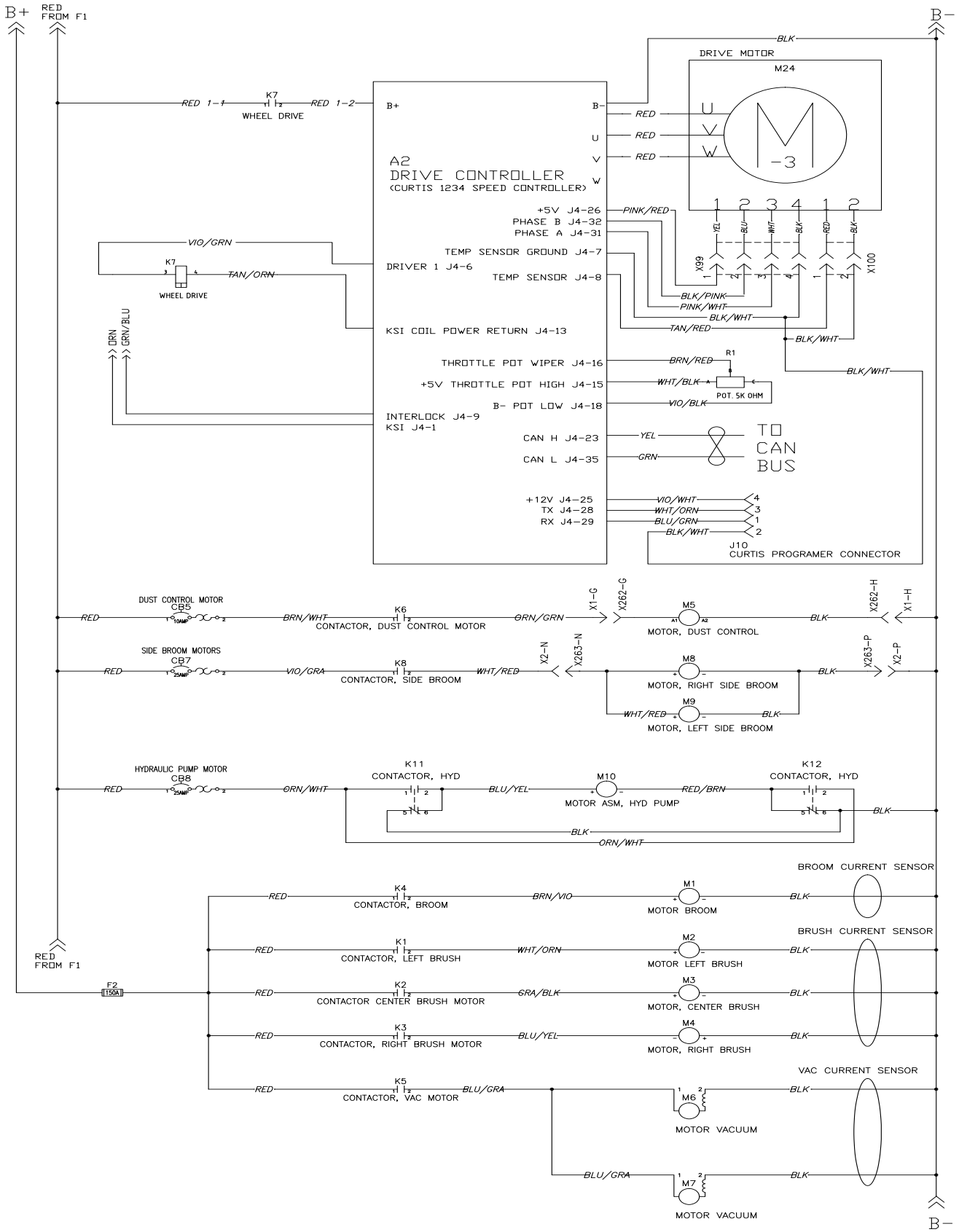


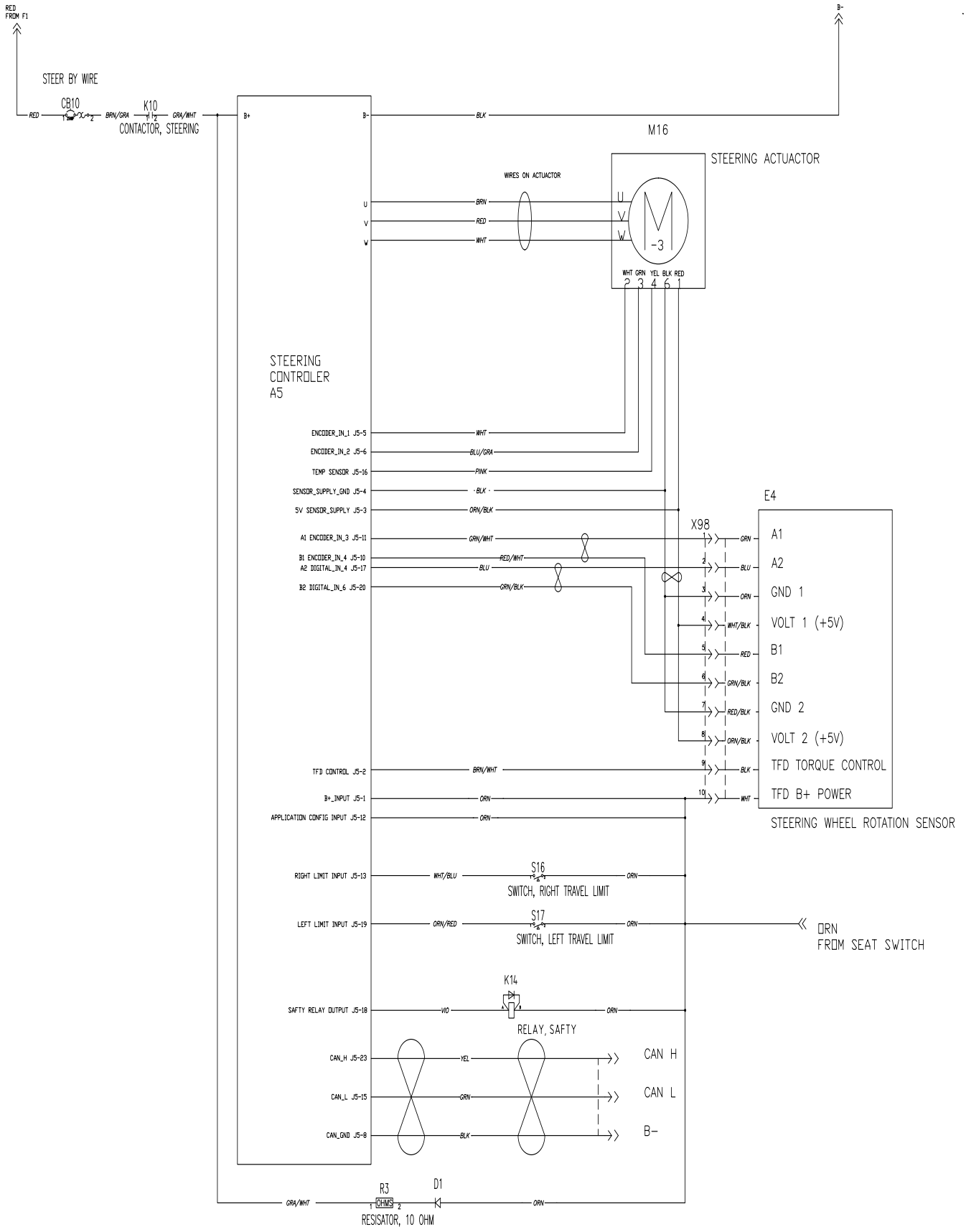
56509170 Rev G (Before SN 1000048160) Sheet 2 of 6



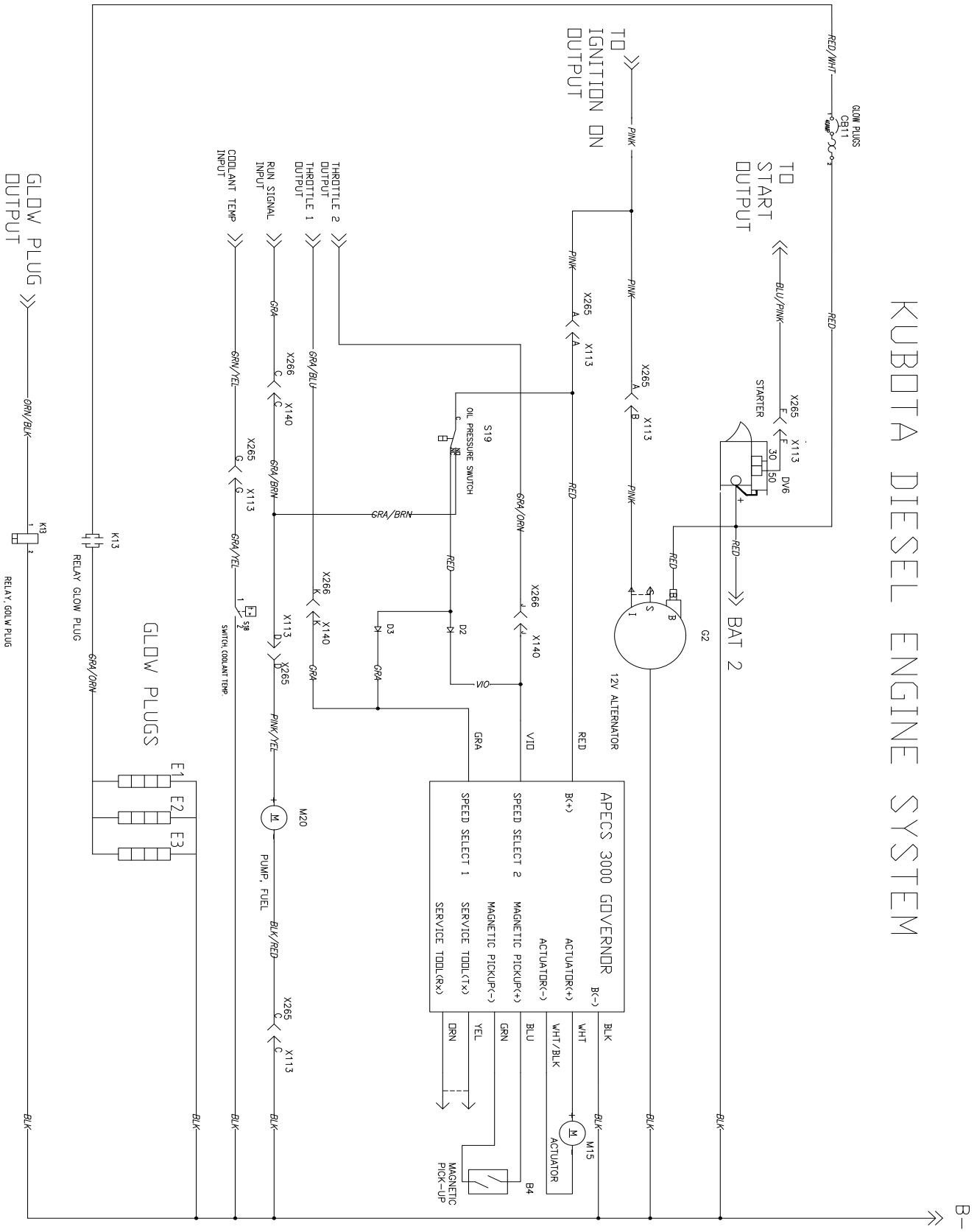
56509170 Rev G (Before SN 1000048160) Sheet 3 of 6



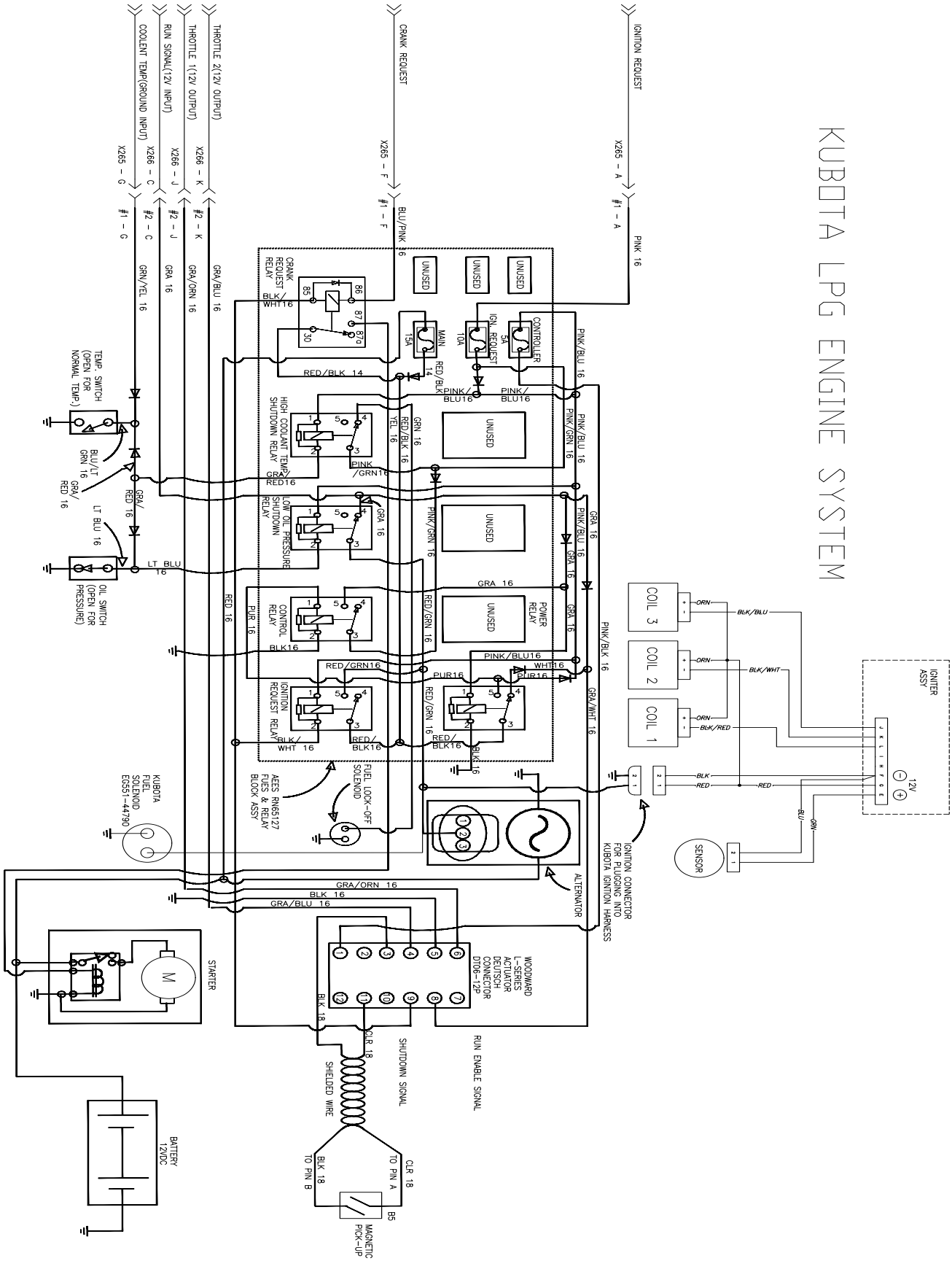
56509170 Rev G (Before SN 1000048160) Sheet 4 of 6



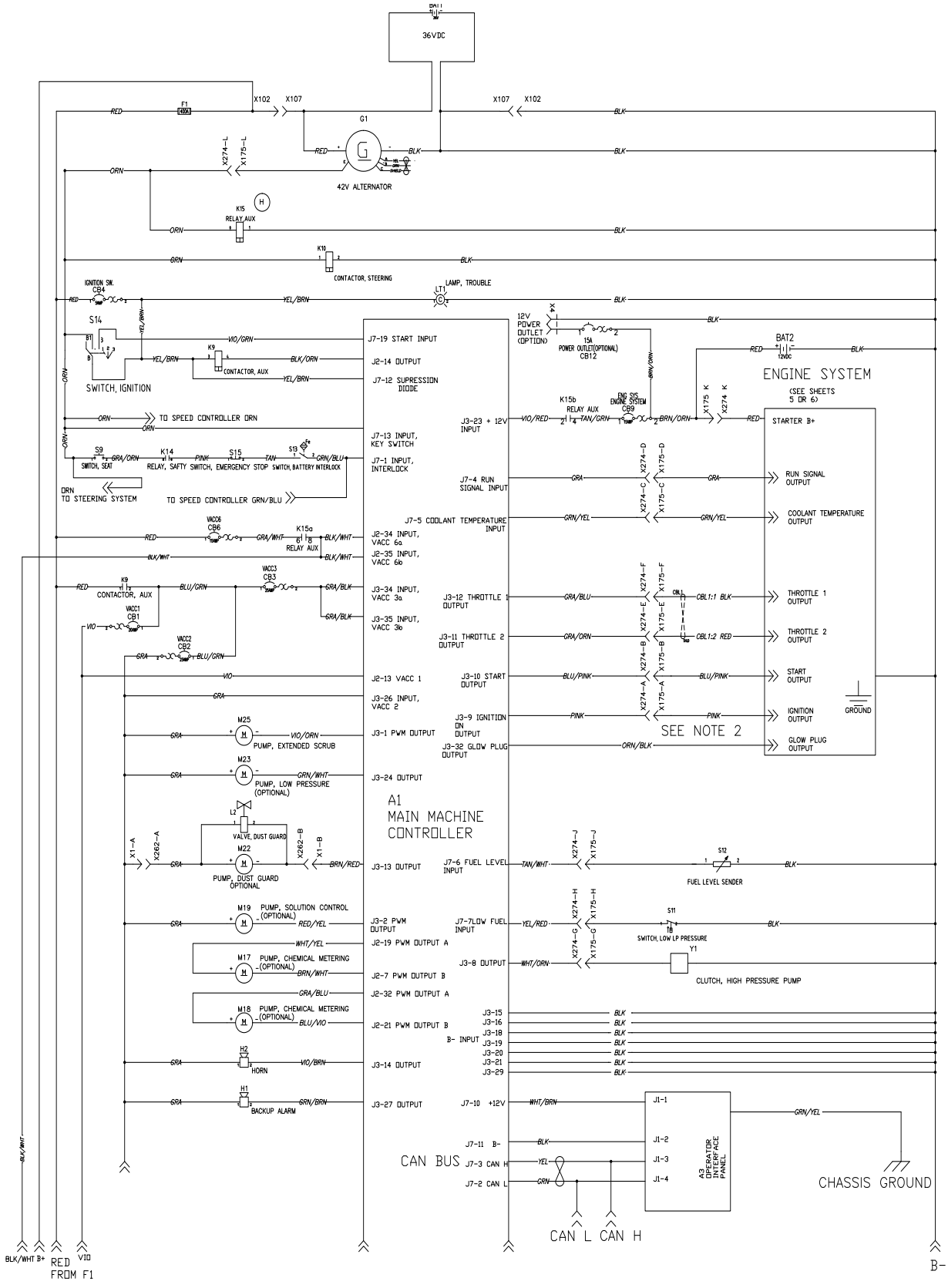
56509170 Rev G (Before SN 1000048160) Sheet 5 of 6



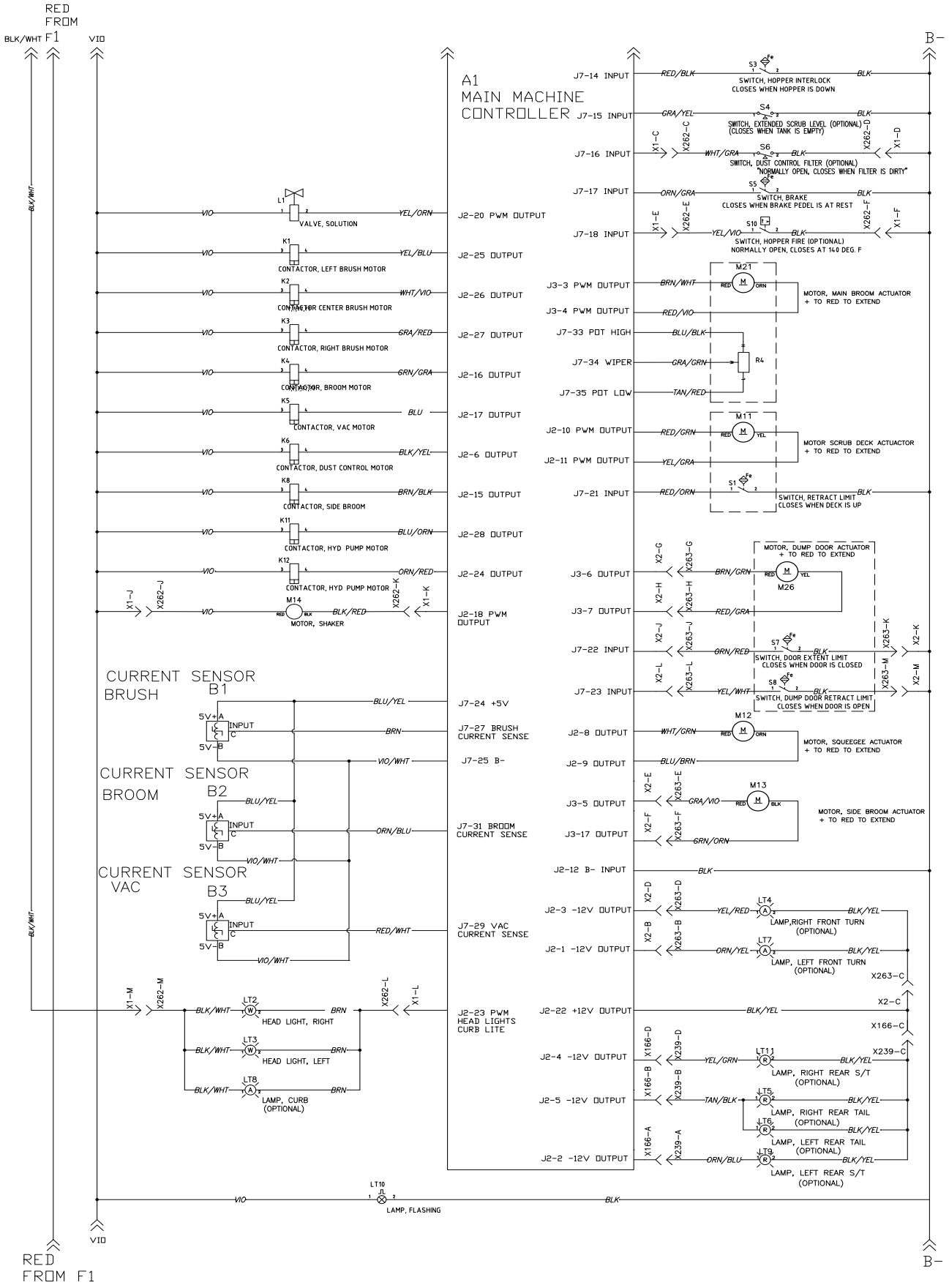
56509170 Rev G (Before SN 1000048160) Sheet 6 of 6



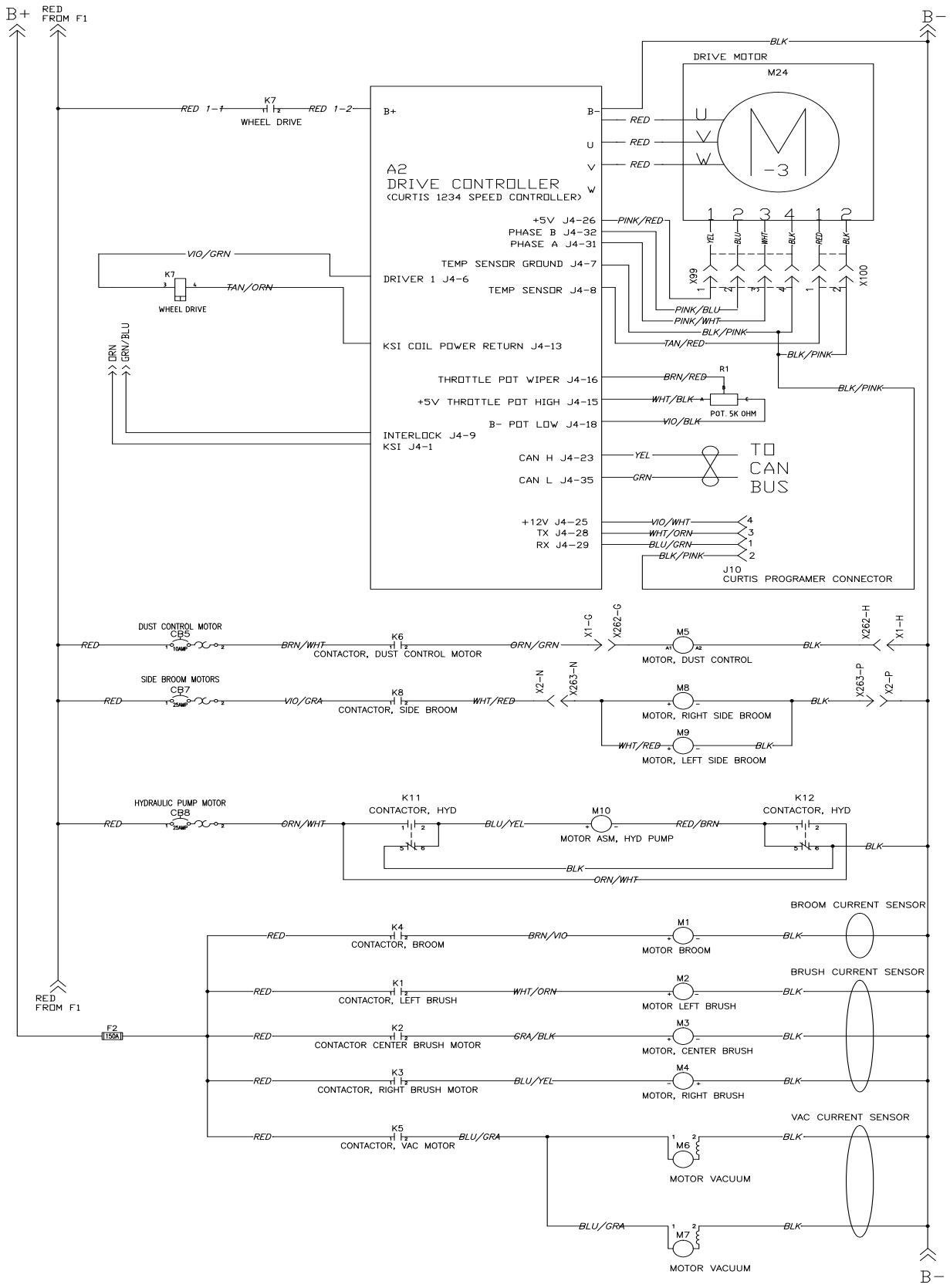
56509170 Rev H (SN 1000048160 and later) Sheet 1 of 7



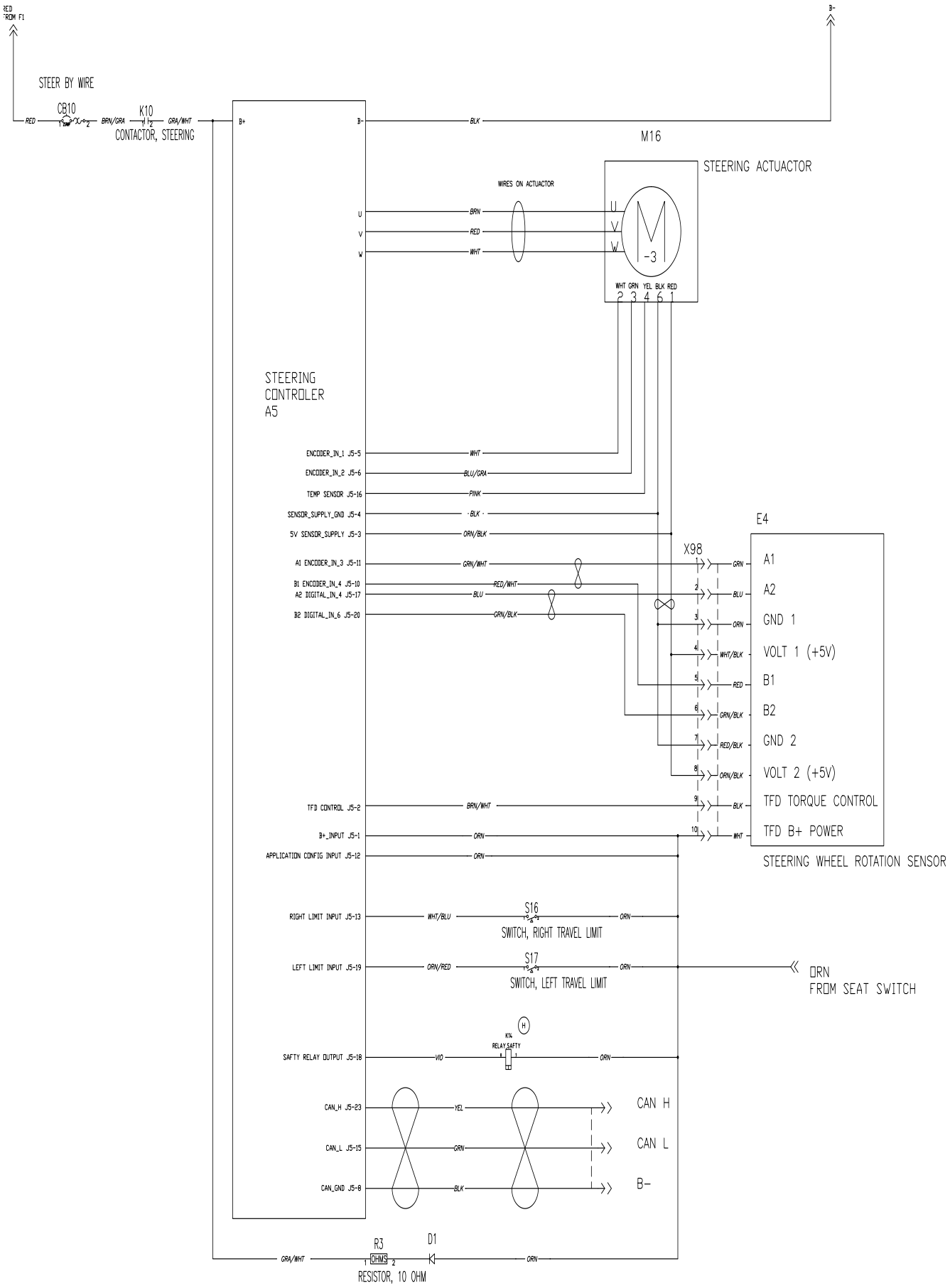
56509170 Rev H (SN 1000048160 and later) Sheet 2 of 7


RED FROM F1
BLK/WHT
VIO
B-
A1
MAIN MACHINE CONTROLLER
J7-14 INPUT
J7-15 INPUT
J7-16 INPUT
J7-17 INPUT
J7-18 INPUT
S3 SWITCH, HOPPER INTERLOCK CLOSES WHEN HOPPER IS DOWN
S4 SWITCH, EXTENDED SCRUB LEVEL (OPTIONAL) (CLOSES WHEN TANK IS EMPTY)
S6 SWITCH, DUST CONTROL FILTER (OPTIONAL) "NORMALLY OPEN, CLOSES WHEN FILTER IS DIRTY"
S5 SWITCH, BRAKE CLOSES WHEN BRAKE PEDEL IS AT REST
S10 SWITCH, HOPPER FIRE (OPTIONAL) NORMALLY OPEN, CLOSES AT 140 DEG. F
L1 VALVE, SOLUTION
J2-20 PWM OUTPUT
K1 CONTACTOR, LEFT BRUSH MOTOR
J2-25 OUTPUT
K2 CONTACTOR, CENTER BRUSH MOTOR
J2-26 OUTPUT
K3 CONTACTOR, RIGHT BRUSH MOTOR
J2-27 OUTPUT
K4 CONTACTOR, BROOM MOTOR
J2-16 OUTPUT
K5 CONTACTOR, VAC MOTOR
J2-17 OUTPUT
K6 CONTACTOR, DUST CONTROL MOTOR
J2-6 OUTPUT
K8 CONTACTOR, SIDE BROOM
J2-15 OUTPUT
K11 CONTACTOR, HYD PUMP MOTOR
J2-28 OUTPUT
K12 CONTACTOR, HYD PUMP MOTOR
J2-24 OUTPUT
M14 MOTOR, SHAKER
J2-18 PWM OUTPUT
M21 MOTOR, MAIN BROOM ACTUATOR + TO RED TO EXTEND
J3-3 PWM OUTPUT
J3-4 PWM OUTPUT
J7-33 POT HIGH
J7-34 WIPER
J7-35 POT LOW
R4
M11 MOTOR SCRUB DECK ACTUACTOR + TO RED TO EXTEND
J2-10 PWM OUTPUT
J2-11 PWM OUTPUT
S1 SWITCH, RETRACT LIMIT CLOSES WHEN DECK IS UP
J7-21 INPUT
M26 MOTOR, DUMP DOOR ACTUATOR + TO RED TO EXTEND
J3-6 OUTPUT
J3-7 OUTPUT
S7 SWITCH, DOOR EXTENT LIMIT CLOSES WHEN DOOR IS CLOSED
J7-22 INPUT
S8 SWITCH, DUMP DOOR RETRACT LIMIT CLOSES WHEN DOOR IS OPEN
J7-23 INPUT
M12 MOTOR, SQUEEGEE ACTUATOR + TO RED TO EXTEND
J2-8 OUTPUT
J2-9 OUTPUT
M13 MOTOR, SIDE BROOM ACTUATOR + TO RED TO EXTEND
J3-5 OUTPUT
J3-17 OUTPUT
CURRENT SENSOR BRUSH B1
J7-24 +5V
J7-27 BRUSH CURRENT SENSE
J7-25 B-
CURRENT SENSOR BROOM B2
J7-31 BROOM CURRENT SENSE
CURRENT SENSOR VAC B3
J7-29 VAC CURRENT SENSE
J2-12 B- INPUT
J2-3 -12V OUTPUT
J2-1 -12V OUTPUT
LT4 LAMP,RIGHT FRONT TURN (OPTIONAL)
LT7 LAMP, LEFT FRONT TURN (OPTIONAL)
J2-22 +12V OUTPUT
LT2 HEAD LIGHT, RIGHT
LT3 HEAD LIGHT, LEFT
LT8 LAMP, CURB (OPTIONAL)
J2-23 PWM HEAD LIGHTS CURB LITE
J2-4 -12V OUTPUT
J2-5 -12V OUTPUT
J2-2 -12V OUTPUT
LT11 LAMP, RIGHT REAR S/T (OPTIONAL)
LT5 LAMP, RIGHT REAR TAIL (OPTIONAL)
LT6 LAMP, LEFT REAR TAIL (OPTIONAL)
LT9 LAMP, LEFT REAR S/T (OPTIONAL)
LT10 LAMP, FLASHING
RED FROM F1
B-

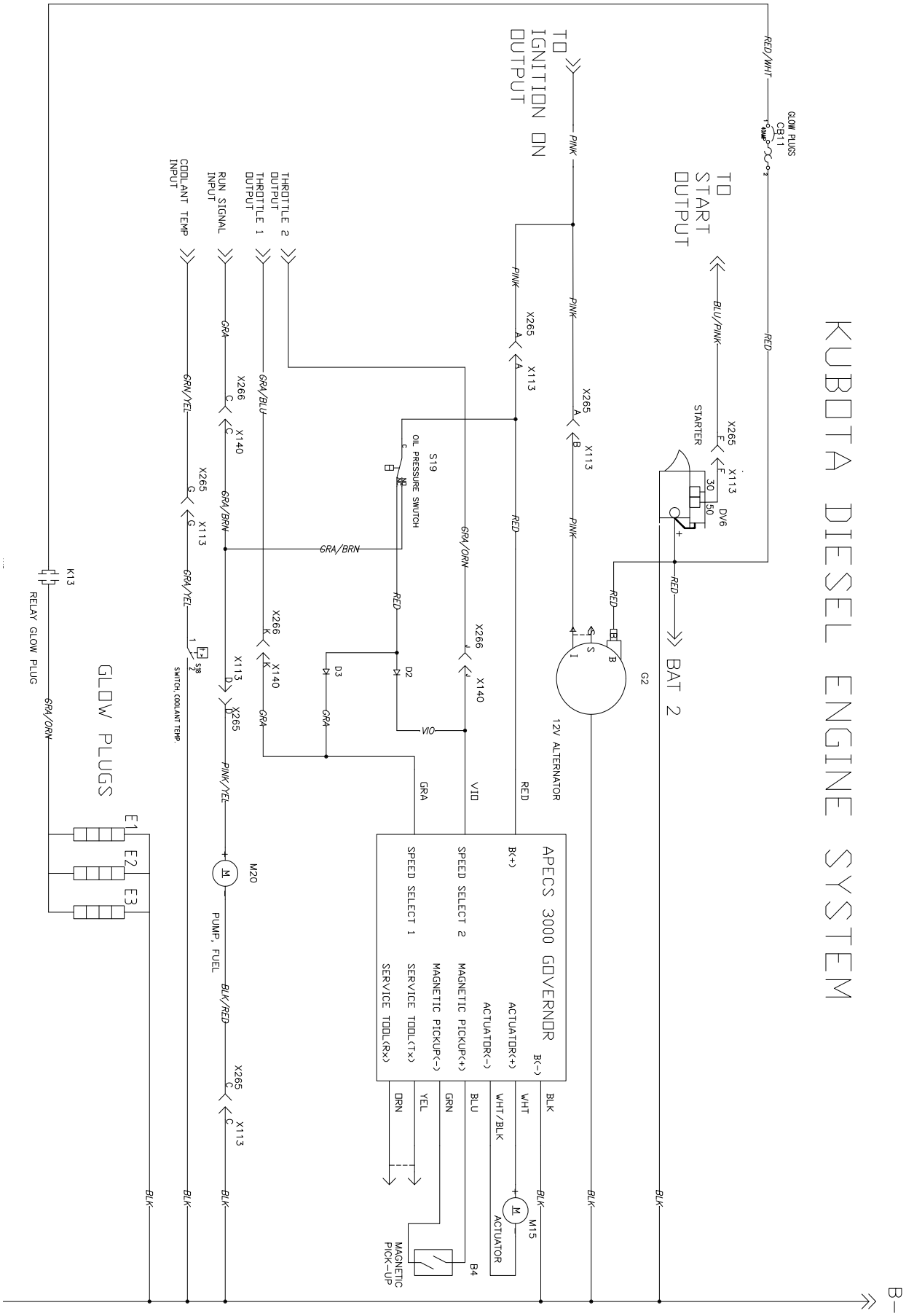
56509170 Rev H (SN 1000048160 and later) Sheet 3 of 7



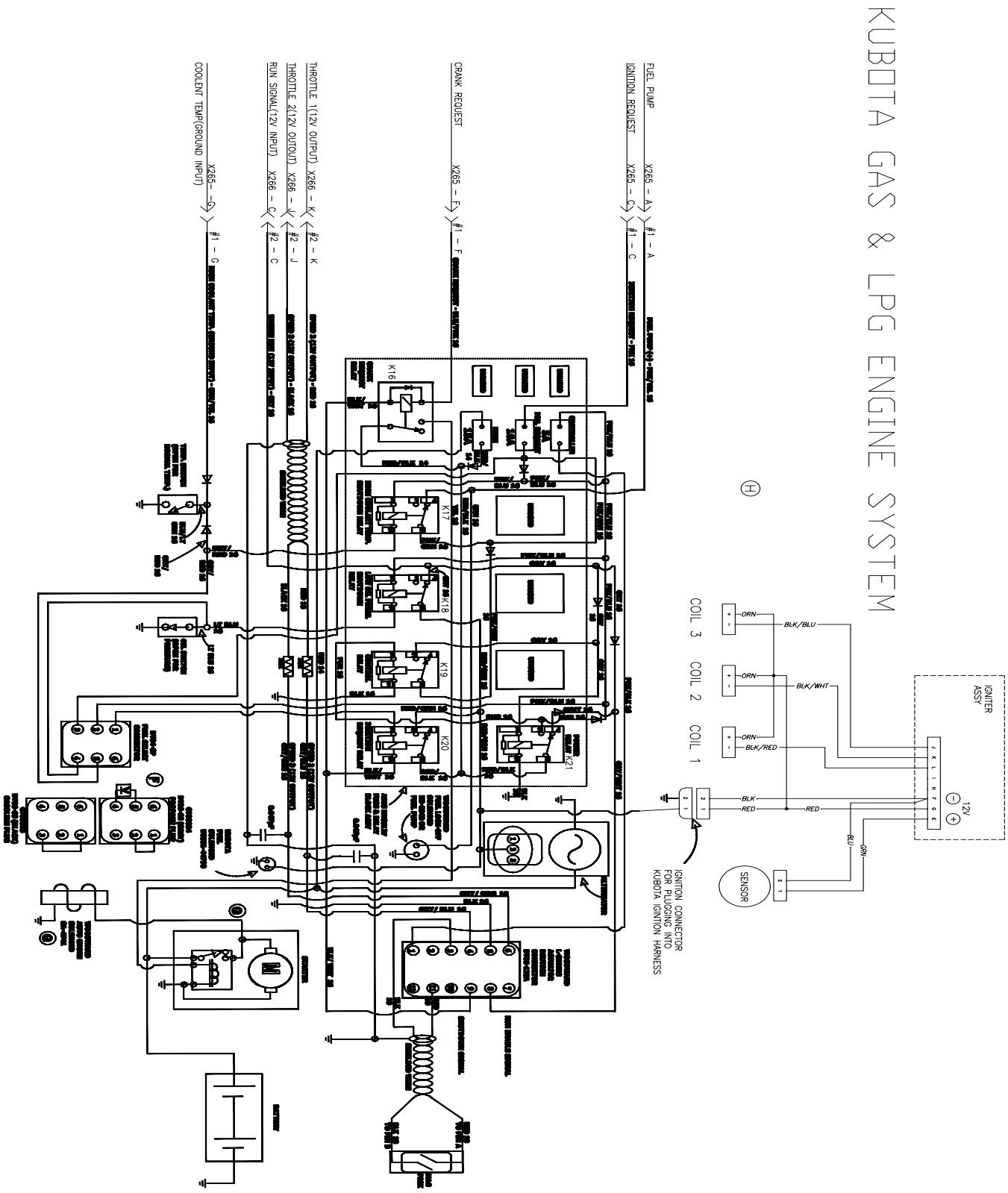
56509170 Rev H (SN 1000048160 and later) Sheet 4 of 7



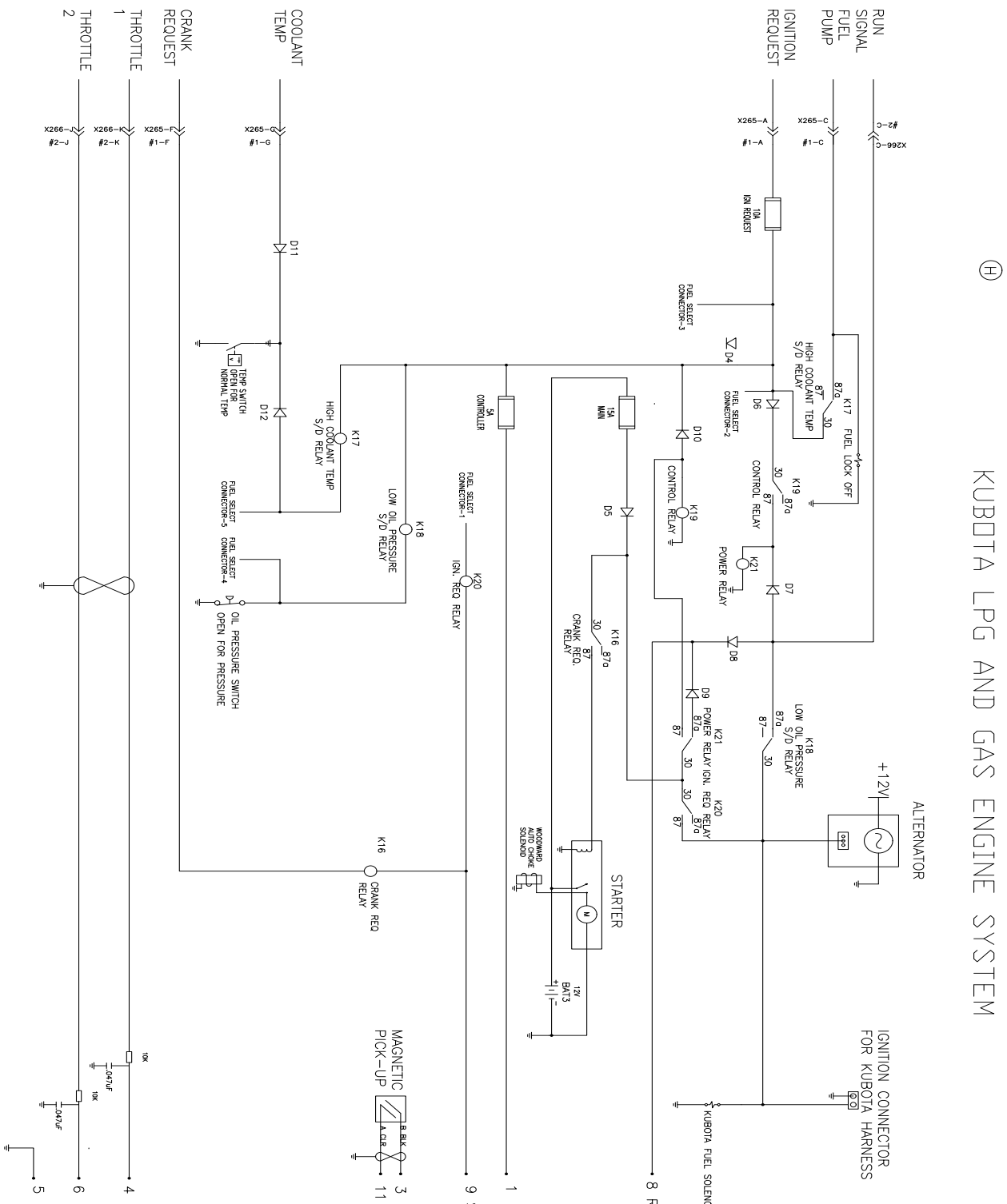
56509170 Rev H (SN 1000048160 and later) Sheet 5 of 7



56509170 Rev H (SN 1000048160 and later) Sheet 6 of 7



56509170 Rev H (SN 1000048160 and later) Sheet 7 of 7 (Sheet 6 of 7 Re-drawn in "ladder style")



Engine System, Diesel

This chapter covers the fuel supply system, engine RPM governor control system and glow plug starting aid. See the Kubota D1305 Workshop Manual 9Y111-00124.pdf for information related to the mechanical engine and high pressure fuel injection system.

Functional Description

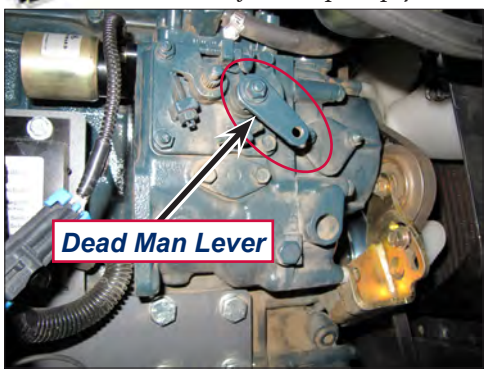
One of the engines available in the CS7000 is a Kubota Diesel (D1305-E3B-KEA-1). It is a three cylinder, liquid cooled, naturally aspirated engine. It has mechanical injector pump that is fitted with an actuator which physically moves the fuel lever inside the pump.

Fuel is stored in a tank on the right side of the engine compartment. The tank swings out to provide easier access to the engine compartment and contains a fuel level sending unit. An electric pump supplies low pressure fuel to the diesel injector pump. There is a replaceable fuel filter cartridge between the fuel pump and the injector pump. The injector pump has s small “return” line that runs to the closest injector. The return circuit is carried from injector to injector where it exits the rear injector and is connected to a hose which returns back to the fuel tank. .

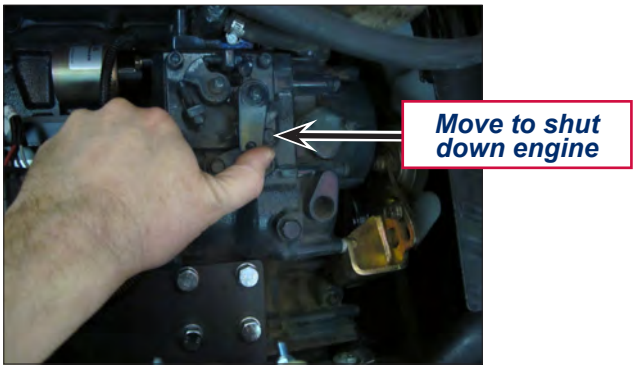
The engine uses glow plugs to aid in starting a cold engine. The main machine controller operates a glow plug relay which supplies power to the glow plugs when needed.

The engine RPM is controlled with the Woodward APECS 3000 Electronic Engine Speed Governing System based on requests from the main machine controller. The main machine controller sends signals to the Woodward Gov. controller to request one of three engine speeds based on operator request or cleaning mode.

Note: There is a “dead man” level on the side of the injector pump that can be used to shut the injection pump fuel down to shut off the engine manually.



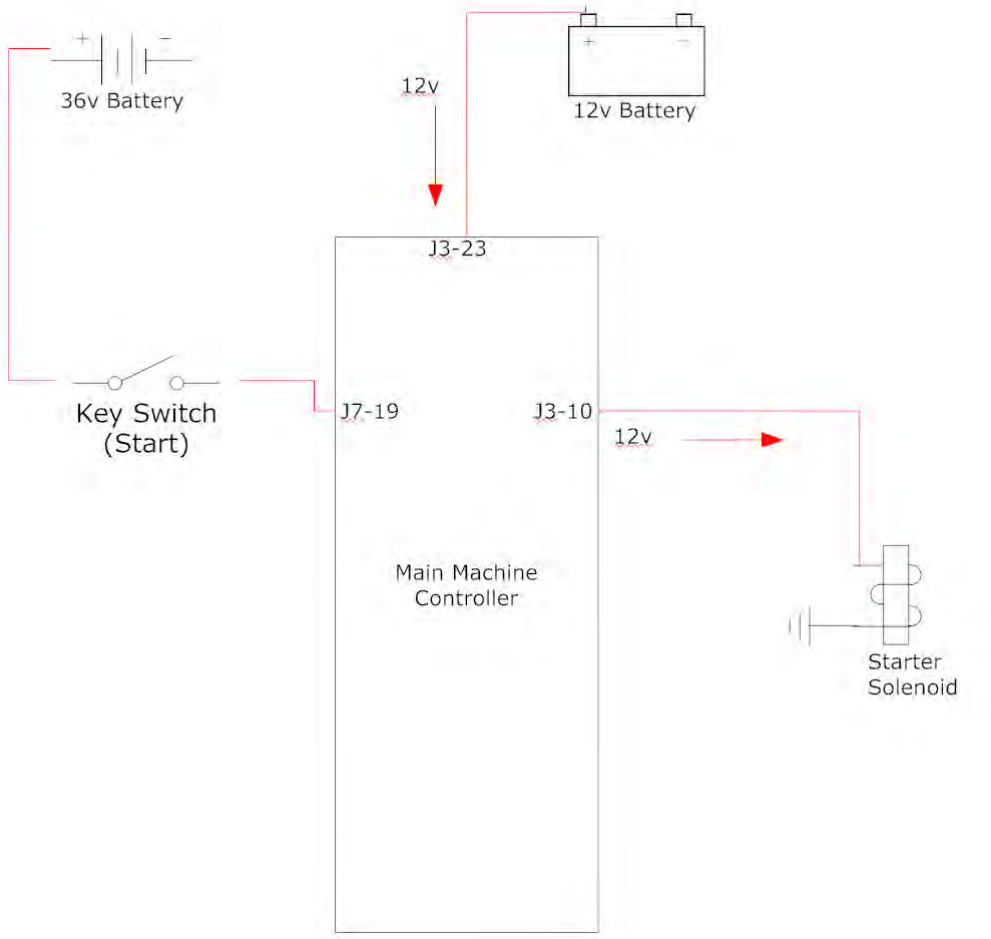
Dead man lever in normal run position



Dead man lever held in shut down position

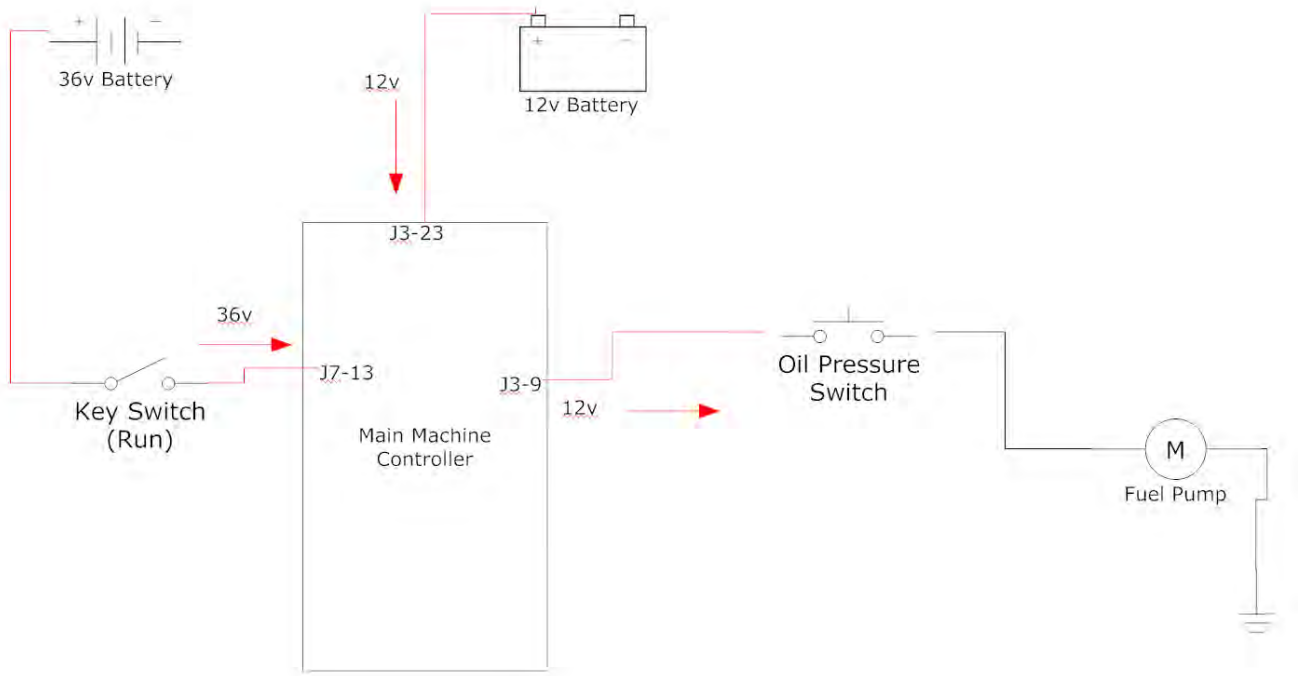
The cooling system consists of a standard radiator and belt driven fan. Note that the fan pushes air away from the engine and out through the radiator.

Engine starter control



To get the engine starter to engage, the key switch is held in the start position which supplies 36 volts to the main machine controller connector J7 pin 19. This is the start input request. The main machine controller receives a 12 V supply on connector J3 pin 23 from the engine starter battery. It uses this voltage supply to send voltage out connector J3 pin 10 to the starter solenoid.

Fuel pump control



The main machine controller uses the same 12 V battery supply from connector J3 pin number 23 to operate the fuel pump. When the key is turned on, 36 volts is supplied to the main machine controller connector J7 pin number 13. In response, the controller sends voltage out connector J3 pin number 9 to the oil pressure switch. As the engine cranks oil pressure builds up causing the oil pressure switch to close and supply voltage to the fuel pump. The other side of the fuel pump is connected to ground. If oil pressure is lost, the oil pressure switch will open removing power from the fuel pump.

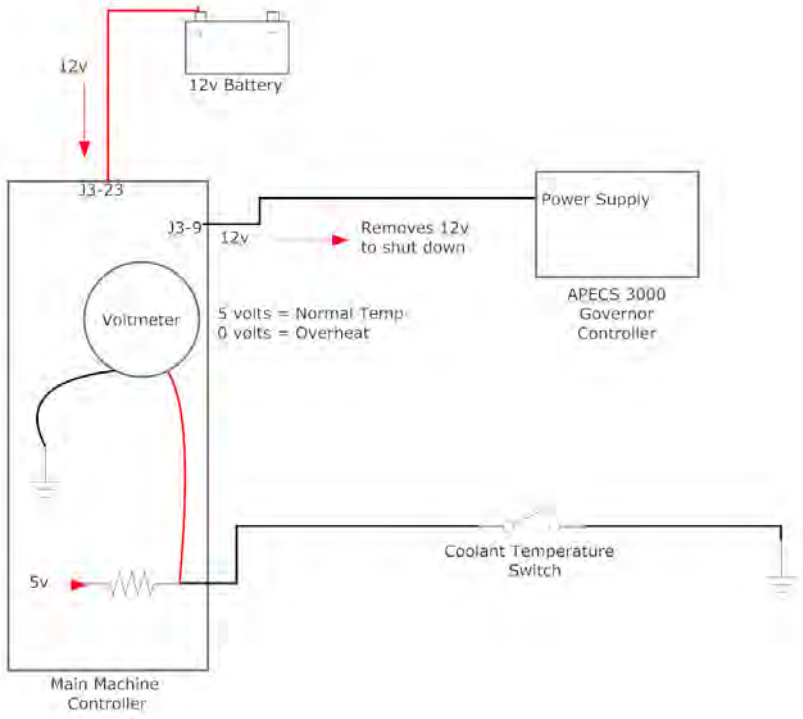
Engine Protection

The engine will be automatically shut down by the main machine controller if the engine overheats or oil pressure is lost.

When the engine is running, the main machine controller sends a 12 volt power supply out on connector J3 pin number 9 to power up the governor controller When the main machine controller wants to shut down the engine, it removes this power supply to the governor controller. When the governor loses the power supply it causes the engine to shut down.

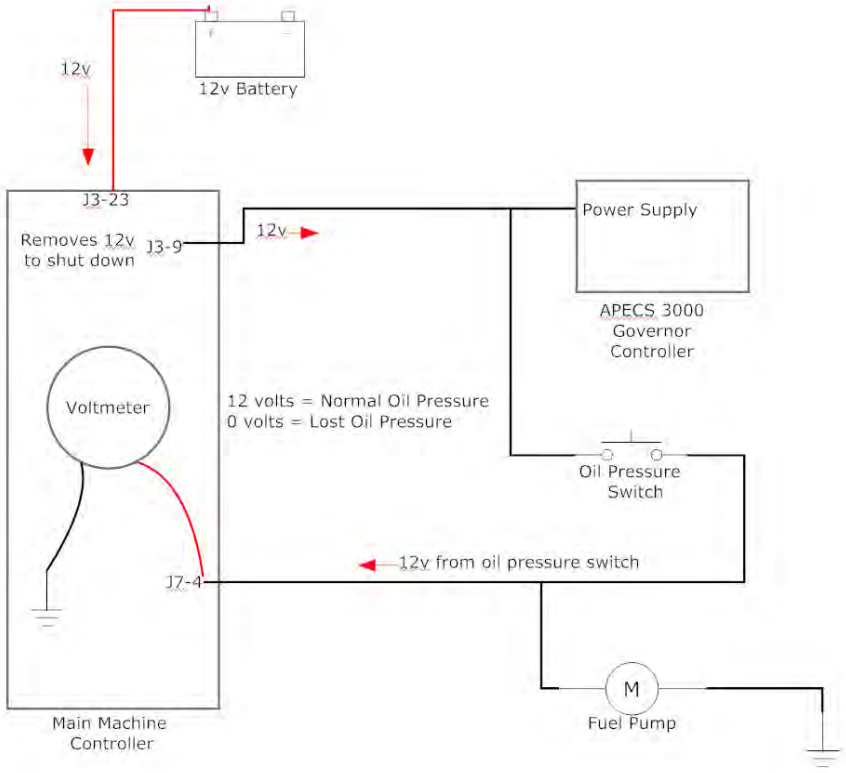
Over Temperature Shutdown

Here is how the engine over temperature shutdown works. To monitor engine temperature, the main machine controller sends a voltage through an internal resistor out connector J7 pin number 5 on the green wire with a yellow stripe to the engine coolant temperature switch. The switch is normally open. When the engine overheats the switch closes. The closing of the switch connects the voltage source to ground which drops the voltage seen by the main machine controller to nearly 0 volts. An engine temperature fault occurs when the coolant sensor switches to ground. This fault will be displayed on the Control panel. In response to the overheat condition, the main machine controller waits five seconds to give the operator time to park the machine then removes the power supply going out connector J3 pin number 9 from the APECS 3000 Governor controller, which causes the engine to shut down.



Low Oil Pressure Shutdown

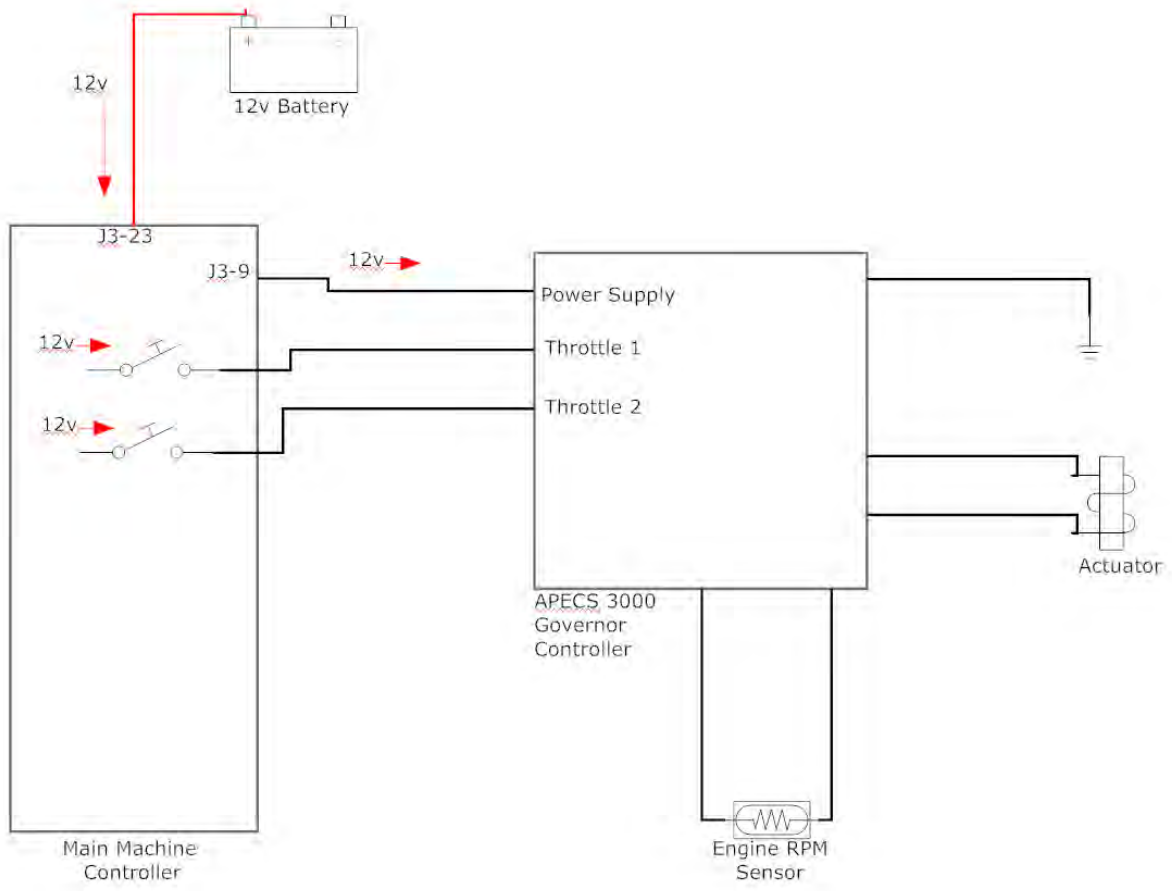
Here is how the low oil pressure shutdown works. The main machine controller sends 12 V out connector J3 pin number 9 to the APECS governor controller and the oil pressure switch. When there is oil pressure, the switch connects the voltage back as an “engine run signal” to the main machine controller connector J7 pin number 4. Once the main machine controller has seen that the engine is running, it continues to monitor that voltage. If engine oil pressure is lost, the “engine run signal” to the main machine controller will also be “lost” (voltage drops from 12v to 0v). In response, the main machine controller sets an oil pressure fault, displays it on the control panel and immediately removes the power supply going out connector J3 pin number 9 from the APECS 3000 Governor controller, which causes the engine to shut down.



Engine RPM control

The Woodward APECS (Advanced Proportional Engine Control System) controller manages the engine RPM through the use of an electronic actuator. The controller monitors the actual engine RPM via a speed sensor which reads the flywheel ring gear teeth and compares it to the desired speed setting. The controller sends out a pulse width modulated signal to an actuator, which is connected to the engine fuel control lever inside the injector pump. The actuator is "spring loaded" in the "no fuel" position. This means that by default, the actuator shuts off the fuel and prevents the engine from running when there is no electrical current available. When the governor wants to increase the engine speed, it increases the amount of current it sends through the actuator.

The main machine controller is responsible for telling the governor controller the desired RPM based on the operator's request or machine operation mode. It communicates this with two circuits; Throttle 1 and Throttle 2. To request idle speed it does not apply voltage to either circuit. To request "Run" speed, it sends out 12 volts on throttle 2 circuit only. To request "maximum power" speed, it sends out 12 volts on throttle 1 circuit only.



Speed Mode	Engine Speed	Throttle 1	Throttle 2
Idle	1700 RPM	0	0
Run	2200 RPM	0	12v
Maximum Power	2400 RPM	12v	0

There are several conditions that will override the user's engine speed request.

- High pressure wash forces to run speed.
- If the engine is at idle speed, the engine will be forced to the run speed when sweeping only or vacuuming only. The force idle (neutral time-out) will return the engine to idle speed.
- If the engine is at idle or run speed, the engine will be forced to maximum power speed when scrubbing only or scrubbing and sweeping. The force idle (neutral time-out) will return the engine to idle speed.
- If the override is run speed, the user can change between maximum power speed and run speed.
- If the override condition goes away (e.g. sweep system turns off) and the user has not changed the engine mode, the engine is returned to the mode before the forced override.

The controller is capable of identifying some fault conditions and displaying a fault code. A flashing LED displays the fault conditions. When power is first applied to the controller, the LED will flash just once for one second to indicate that the LED is operational. If there is more than one fault, the LED will flash them all. If there are no faults the LED will flash once every reset and from then on indicate the detection of engine speed. The controller will attempt to shut the engine down for all faults and will not permit starting after reset with fault 1, 5 and 6.

Note: If any fault in the APECS governor control system causes the engine to stall, the Engine Warning message will be displayed on the control panel. This is because once the engine stalls, engine oil pressure is lost and the main machine controller responds as it always does when it sees a loss of oil pressure after the engine has been running. This means the main machine controller will display the engine warning message and remove the power supply from the APECS controller causing it to power down and turn off its status LED light.

Flash Code	Fault	Remedy
1	APECS unit not calibrated	Calibrate APECS unit
2	Engine Speed Excessive	Check parameter setting. Overspeed criteria may be too sensitive Check for electrical noise entering controller. Check wiring and connections. Check case ground. Make sure linkage moves freely, without backlash. Check tip of speed sensor.
3	Engine Speed too low	Check parameter settings. Check linkage and the actuator travel. Check load and make sure it is not greater than the capacity of the engine.

Flash Code	Fault	Remedy
4	Engine shutdown due to engine protection input	Check parameter settings. Check what may have triggered the protection input. (Loss of oil pressure, engine overheat)
5	Factory settings lost	If calibration file is available, download calibration file and cycle power again. If controller still does not work or if no calibration file is available, consult factory.
6	APECS unit failed	Electrical noise may be entering the controller. Check wiring, shielding and connections to controller. Cycle power to engine. If controller still does not work, consult factory.

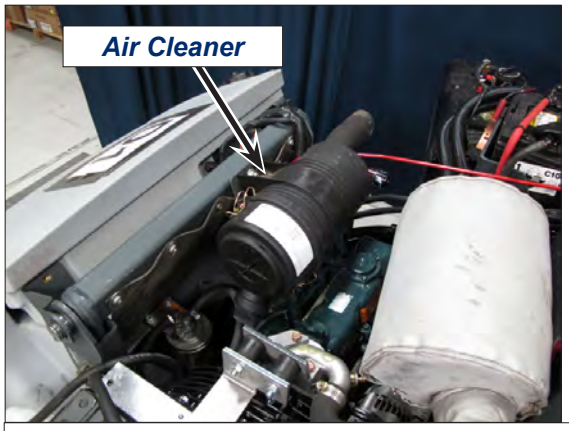
Glow plug control

The engine is equipped with glow plugs to assist starting a cold engine. The glow plugs have an internal resistive element that increases in resistance as it heats up. This protects the glow plug from overheating by reducing the current flow as it gets hot.

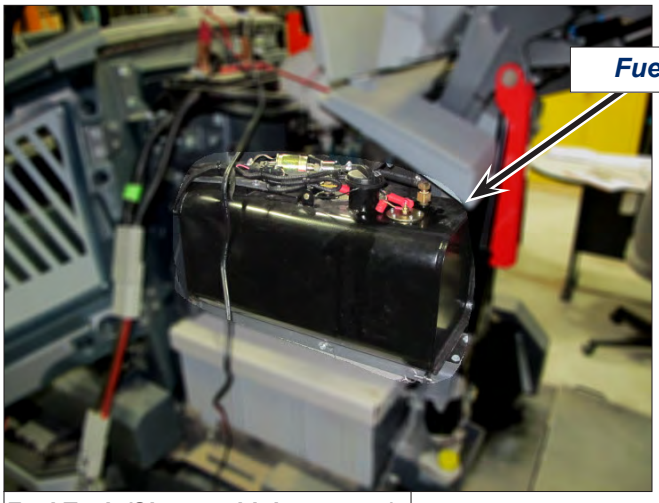
Whenever the key is turned on, the main machine controller tells the control panel to display the “glow plugs on” icon and sends out 12 V from connector J3 pin number 32 to the glow plug relay winding. Since the other side of the winding is connected to ground, this energizes relay which in turn supplies power from circuit breaker 11 to the glow plugs. After approximately 10 seconds, the main machine controller de-energizes the glow plug relay by removing the 12 volts from the winding which also removes the power from the glow plugs.

Component Locations

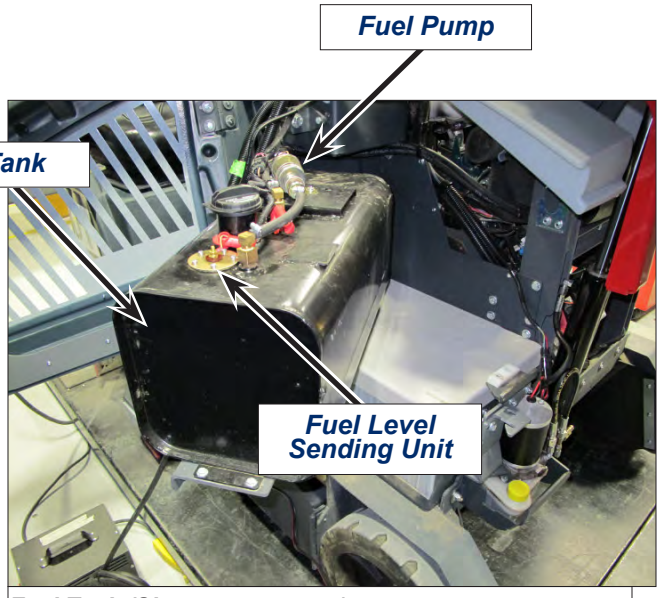
- Fuel tank - Right side of engine compartment
- Fuel level sending unit - Top of fuel tank
- Fuel pump - Top of fuel tank
- Fuel filter - Front left engine compartment area. Mounted on frame between engine and hopper.
- Injector pump
- APECS Governor Controller - Front engine area mounted on engine.
- Glow plugs
- Glow plug relay - Electrical panel area
- Engine starter
- Alternator (42v)
- Engine alternator (12v)
- Oil pressure switch
- Coolant temperature switch
- Actuator
- Engine RPM sensor
- Air Cleaner



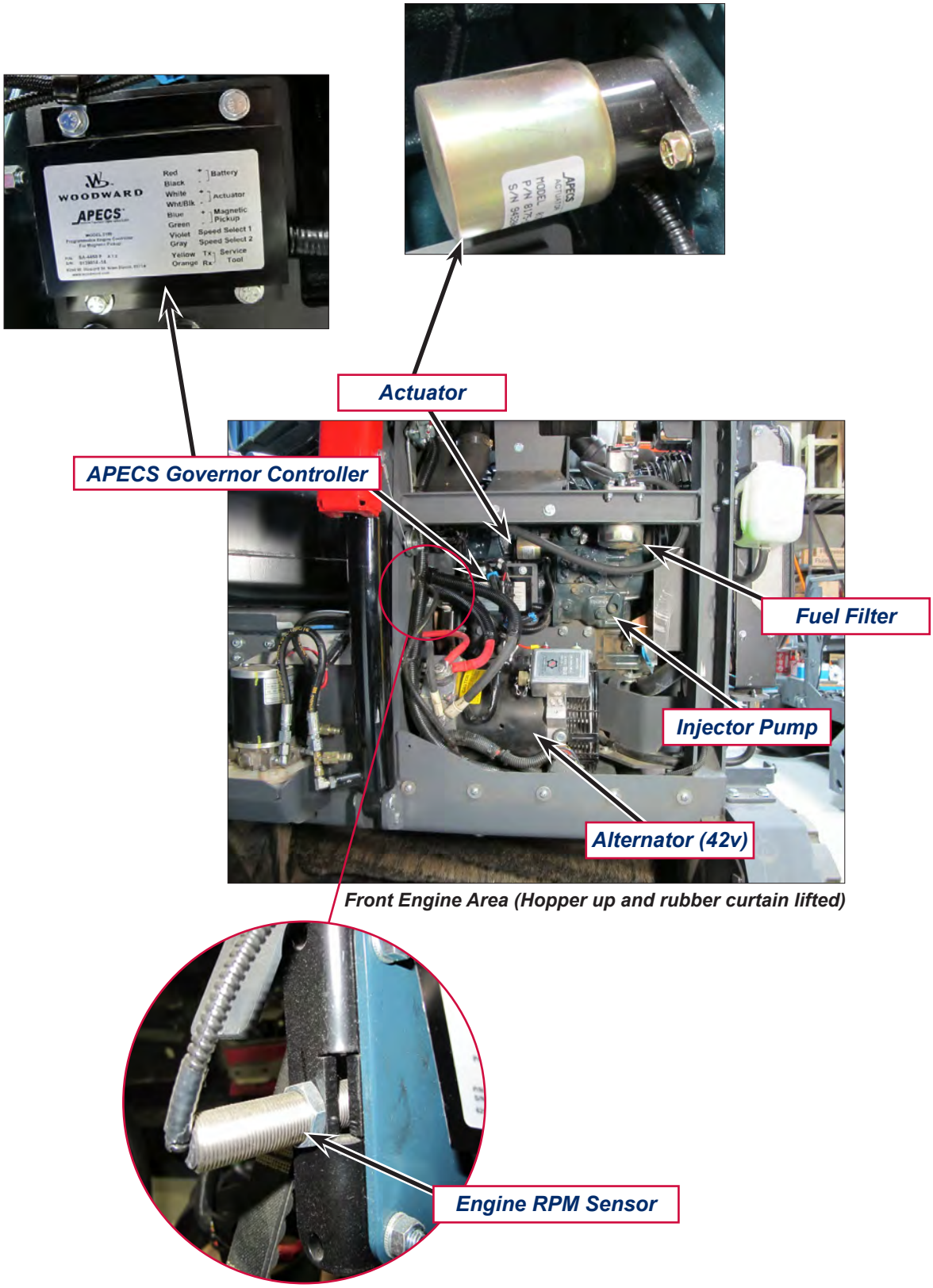
Top of engine compartment with top covers removed



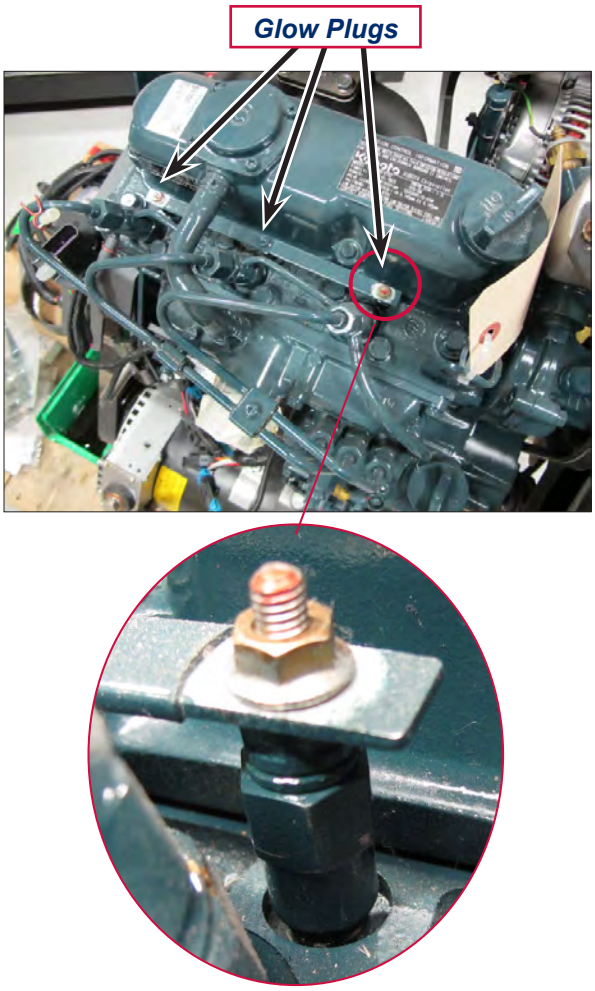
Fuel Tank (Shown with hopper up)

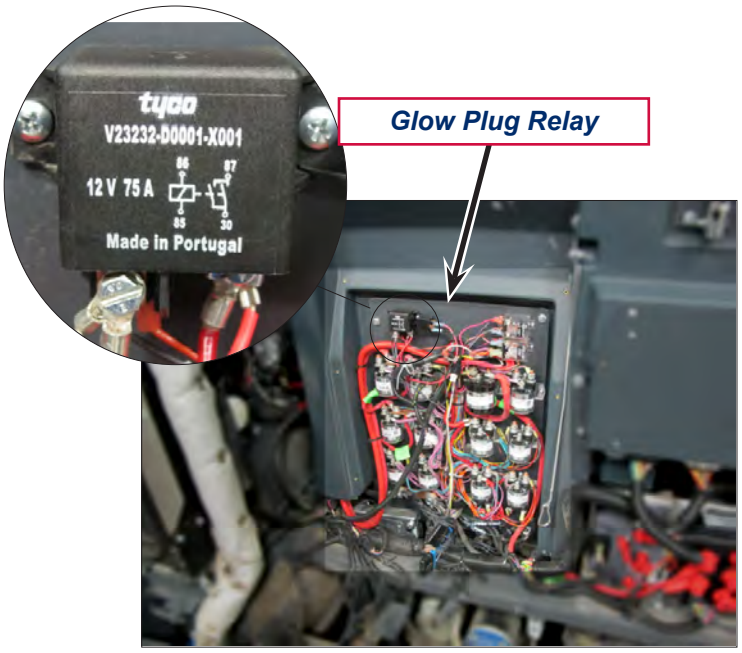


Fuel Tank (Shown swung out)

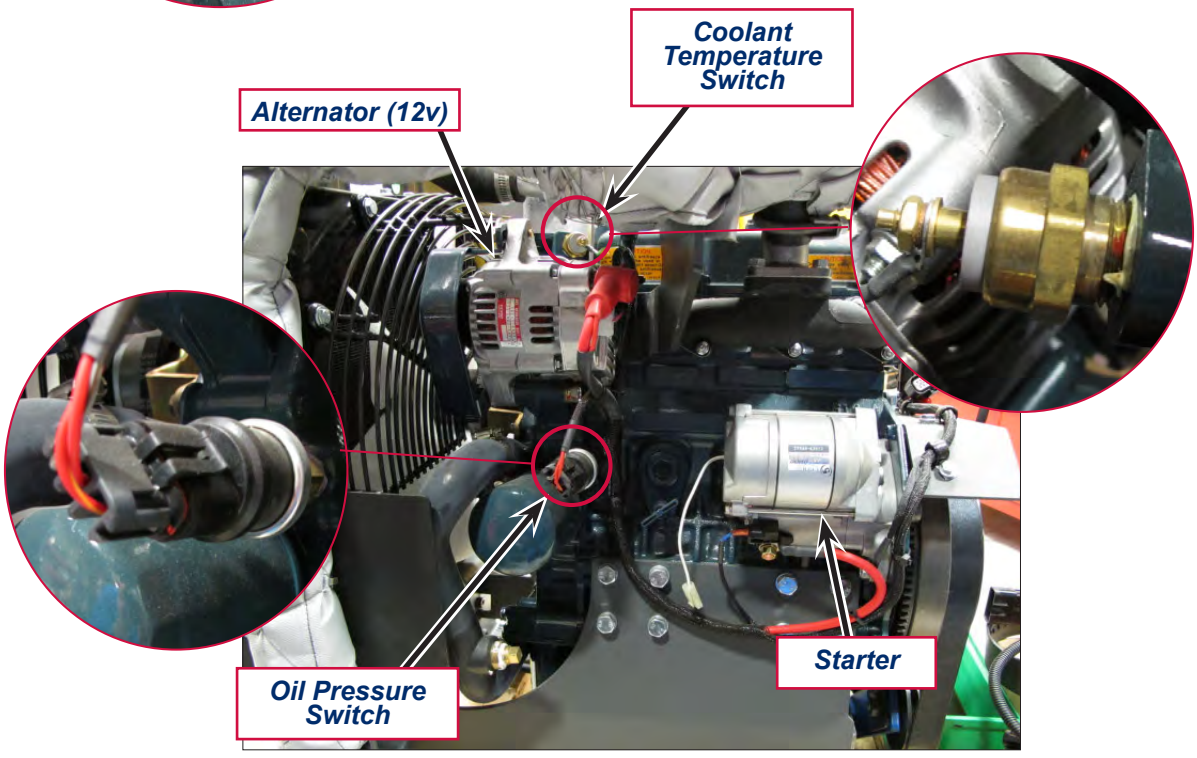


Front Engine Area (Hopper up and rubber curtain lifted)





Electrical Panel



Engine - Back Side

Maintenance and Adjustments

Diesel Engine Maintenance Schedule

First 50 hours:

- Change engine oil and filter

Every 50 hours:

- Check fuel hoses and clamps.
- Check restricted air filter indicator. Replace air filters as needed.

Every 100 hours:

- Check fan belt tension.
- Check engine starting battery

Every 200 hours:

- Change engine oil and filter
- Check radiator hoses and clamps
- Check intake air hoses

Every 400 hours:

- Replace the fuel filter

Every 500 hours:

- Flush cooling system
- Replace fan belt

Every 800 hours:

- Check valve clearance

Every 1500 hours:

- Check injection nozzle pressure

Every 3000 hours:

- Check injection pump timing

Every 2 years

- Replace radiator hoses and clamps
- Replace fuel hoses and clamps
- Replace intake air hoses
- Replace engine starting battery

Change Engine Oil and Oil Filter

1. Drain the recovery tank for later removal.
2. Shut off the engine and allow it to cool sufficiently to avoid burning yourself with hot engine oil.
3. Remove the left side engine cover.
4. Tip the recovery tank outward. Remove the squeegee vacuum hose and release the recovery tank tether cable, then lower the recovery tank to the ground for better access to the engine oil filter area.
5. Remove the oil filter with an oil filter wrench.
6. Apply a light coat of engine oil to the new filter cartridge gasket.
7. Screw the new cartridge on and tighten by hand. Over tightening may damage the gasket.
8. Remove the remote oil drain hose end from the radiator bracket.
9. Remove the plug and drain the oil into a suitable container.
10. Reinstall the plug-and reattach the drain hose to the radiator bracket.
11. Refill the engine with oil.

Change Engine Coolant

1. Allow the engine to cool sufficiently to relieve cooling system pressure and avoid burns.
2. Remove the radiator cap.
3. Remove the left side engine cover.
4. Locate the remote engine coolant drain hose, remove the plug and direct the coolant into a suitable container.
5. Reinstall the drain plug and reposition the drain hose.
6. Refill with a 50/50 mixture of engine antifreeze and water.

Replace Fuel Filter

1. Raise the hopper, engage the hopper prop rod and lower the hopper onto the safety lock.
2. Loosen the screws along the bottom edge of the rubber curtain in front of the engine compartment and move the curtain in order to gain access to the fuel filter.
3. Unscrew the filter from the filter base.
4. Apply a light coat of fuel oil on the cartridge gasket and screw it on by hand-tightening.
5. Bleed the air out of the fuel system as directed below, reinstall the rubber curtain and lower the hopper.

Bleed Fuel System

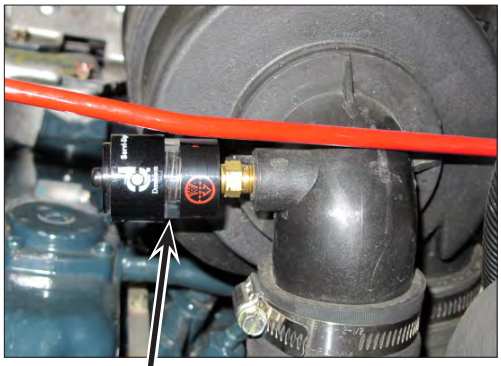
Bleeding air out of the fuel system is required if the engine ran out of fuel, the fuel filter has been replaced or the fuel lines have been opened.

CAUTION: To avoid personal injury; Do not bleed a hot engine as this could cause fuel to spill onto a hot exhaust manifold creating a danger of fire.

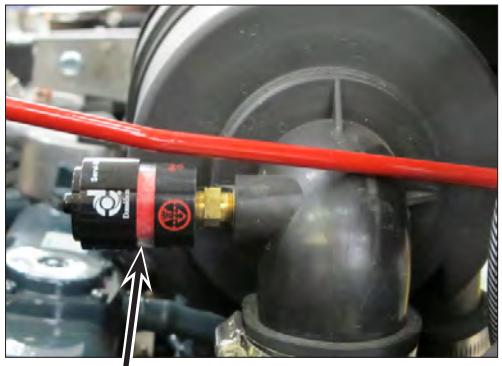
1. Loosen the air vent plug at the top of the fuel filter housing.
2. Operate the fuel pump. (Cranking engine or jump with 12v power supply).
3. Tighten the air vent plug when bubbles no longer come up.

Inspect Air Filter

Check the service indicator mounted on the air cleaner elbow. If the red disc is visible in the “window”, the filters should be cleaned or replaced.



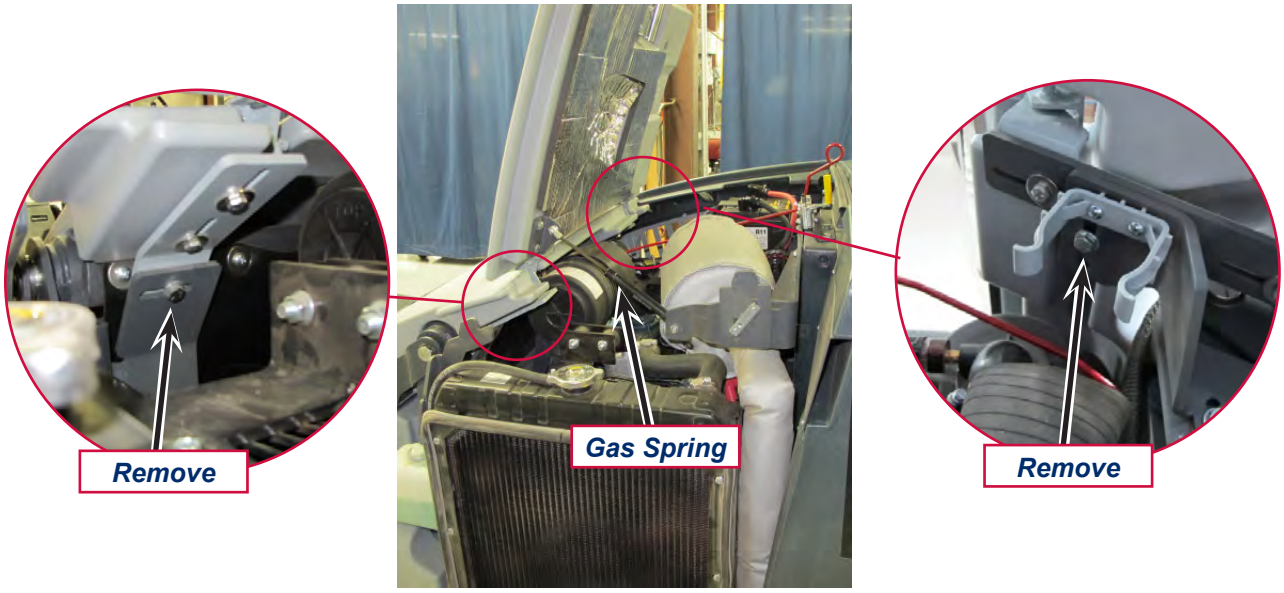
Clear Window = Okay



Red in Window = Restricted Filters

Replace Air Filters

1. Remove left side engine cover.
2. Open right side engine cover and swing out fuel tank.
3. Remove the top engine covers by:
   a. Disconnecting the gas spring from one end.
   b. Remove two bolts, one on each side, under the cover and lift the cover assembly off.



Remove Top Engine Cover Fasteners

4. Release the latches and remove the air filter housing cover.
5. Remove the outer filter element.
6. Blow out air cleaner housing with compressed air with inner filter element still in place to prevent dirt from entering the engine air intake.
7. Remove the inner filter element.
8. Clean residual dust from the inside of the air cleaner housing, taking care to prevent any dirt or debris from entering the air intake.
9. Install a new inner filter element and then the new outer filter element making sure that they seal well at their ends.
10. Install the air cleaner housing cover. “Top” is indicated on the cover.
11. Set the top engine cover in place.
12. Install the two fasteners finger tight, then close the cover and allowing it to latch properly.
13. Now, tighten the fasteners with a wrench.
14. Open the top cover, swing the fuel tank back into position and the right engine cover.
15. Install the left engine cover.

Troubleshooting

No crank – The starter does not engage

Possible causes	Check
36v Battery Pack drained	Battery pack voltage
Engine Battery	Load test battery
Starter	Check power to starter solenoid
Battery Cable	Check voltage drop from battery positive to starter battery terminal.
Engine Ground	Check voltage drop from starter case to battery negative.
No voltage to the starter solenoid	Check for tripped circuit breaker #9 (CB9)
• Auxiliary Relay • Key Switch • Main Machine controller	Check for power to the main machine controller from the Auxiliary Relay
	Check for power to the main machine controller from Key Switch cranking circuit
	Check powers, grounds, inputs and crank request output

Cranks but does not start

Possible causes:

- No fuel
  - Empty Tank
  - Insufficient fuel supply
    - Clogged Filter
    - Clogged line
    - Fuel pump
- Contaminated fuel
- APECS governor controller
- Engine RPM Sensor
- Actuator
- Incorrect injection timing
- Injection pump
- Mechanical engine
  - Insufficient compression
  - Fuel camshaft worn
- Plugged Intake
- Plugged Exhaust

Diagnostic steps:

1. Check governor control system.
   a. Does the APECS governor controller status light flash once immediately following “key on”?

      If not, check power and grounds for the APECS governor controller

      If so, go on to next step

   b. Does the status light come on during cranking?

      If not, check the Engine RPM sensor input. (Resistance and voltage output while cranking)

      If so, go on to next step

   c. Is there more than 4 volts available to the actuator during cranking?

      If not, the governor controller may have failed.

      If so, the governor controller appears to be working correctly. Check the fuel actuator

2. Check the fuel actuator
   a. Check the actuator resistance. It should be around 3.0 ohms.

      If it is open or shorted, replace the actuator. If it is Okay, go to the next test.

   b. Substitute the function of the actuator by removing it from the injection pump and operating the throttle control manually. (You can reach into the hole and operate it with your finger or use the dead man lever on the side of the injector pump)

3. Check fuel system
   a. Check the fuel for contamination

   b. Check the fuel pressure to the injector pump during cranking

      If the fuel supply system is Okay, check the mechanical engine.

4. Check mechanical engine
   a. Check compression

   b. Check for plugged intake or exhaust

Cannot Achieve Either Run or Maximum Engine Speed Settings (Run 2200 RPM, Maximum Power 2400 RPM).

The approach to diagnosing an engine RPM control problem is to check the inputs to the governor controller and check the output to the actuator. If the inputs are good and the output is bad, the conclusion is that the controller is the problem. If the output control is okay but the RPM doesn't change, then the actuator is the likely problem. However, don't forget that insufficient fuel supply or a restricted exhaust could appear like an RPM control problem if the engine cannot run well enough to achieve a higher RPM.

Possible Causes:

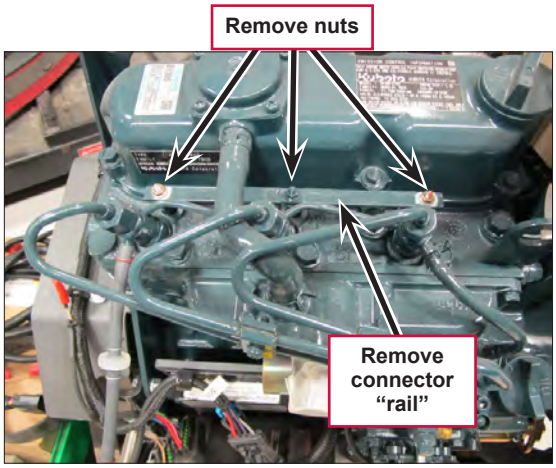
- Actuator
- APECS 3000 Governor Controller
- Wiring
- Main Machine Controller

Diagnostic steps:

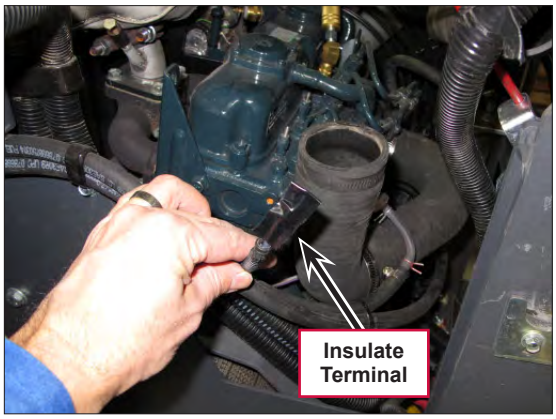
1. Check the power and ground supplies to the controller.
    a. Is there sufficient power and ground?
        ◦ If so, go on to check the speed request inputs.
        ◦ If not, repair.
2. Check the speed request inputs
    a. With the engine running press the engine speed button and check for 12v to the throttle 1 and throttle 2 wires at the governor controller.
    b. Is 12v present on either of the throttle wires with the engine running at idle speed?
        ◦ If so, go on to check the actuator output
        ◦ If not, check the wiring between the main machine controller and the governor controller.
3. Check the actuator output.
    a. Does it change with the speed request?
        ◦ If so, the actuator is the likely problem.
        ◦ If not, the controller appears to be the problem.

Compression Test

1. Begin with a fully charged battery.
2. Remove the air cleaner assembly. Cover the air inlet opening to prevent foreign objects from falling into the engine.
3. Remove the glow plug electrical connector nuts and connector “rail”.



4. Insulate the electric terminal that feeds the rail to prevent it from shorting to ground.



5. Clean the area around the glow plugs to prevent any debris from falling into the engine cylinders when they are removed. Remove the glow plugs.
6. To test the compression of one of the cylinders, screw in an appropriate adapter into the glow plug threads in the cylinder head and attach a suitable compression gauge. Pictured are Snap-On Diesel Compression gauge EEPD500 used with compression test adapter fitting TU-15-35 and coupler M3569.